

INVERTER M4000 **INSTRUCTION MANUAL**

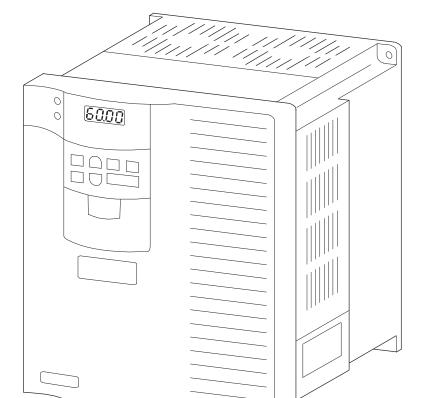
M 4500-001 to 100

OUTLINE

Chapter 1

INSTALLATION AND WIRING

Chapter 2



OPERATION/ CONTROL

Chapter 3

PARAMETERS

Chapter 4

PROTECTIVE FUNCTIONS

Chapter 5

SPECIFICATIONS

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Thank you for choosing this MGI Inverter.

This instruction manual gives handling information and precautions for use of this equipment.

Incorrect handling might cause an unexpected fault. Before using the inverter, please read this manual carefully to use the equipment to its optimum.

Please forward this manual to the end user.

This section is specifically about safety matters

Do not attempt to install, operate, maintain or inspect the inverter until you have read through this instruction manual and appended documents carefully and can use the equipment correctly.

Do not use the inverter until you have a full knowledge of the equipment, safety information and instructions.

In this instruction manual, the safety instruction levels are classified into "WARNING" and "CAUTION".



Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.



Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

SAFETY INSTRUCTIONS

1. Electric Shock Prevention

A WARNING

- While power is on or when the inverter is running, do not open the front cover. You may get an electric shock.
- Do not run the inverter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals or the charging part of the circuitry and get an electric shock.
- If power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, switch power off, wait for more than at least 10 minutes and check for the presence of any residual voltage with a meter (check chapter 2 for further details.) etc.
- Earth the inverter.
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.
- Operate the switches with dry hands to prevent an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.
- Do not change the cooling fan while power is on. To do so will invite a hazardous condition.

2. Fire Prevention

/!\CAUTION

- Mount the inverter on an incombustible surface. Installing the inverter directly on or near a combustible surface could lead to a fire.
- If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
- Do not connect a resistor directly to the DC terminals P, N. This could cause a fire.

3. Injury Prevention

/ CAUTION

- Apply only the voltage specified in the instruction manual to each terminal to prevent damage etc.
- Ensure that the cables are connected to the correct terminals. Otherwise, damage etc. may occur.
- Always make sure that polarity is correct to prevent damage etc.
- After the inverter has been operating for a relatively long period of time, do not touch the inverter as it may be hot and you may get burnt.

4. Additional instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.:

(1) Transportation and installation

CAUTION

- When carrying products, use correct lifting gear to prevent injury.
- Do not stack the inverter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the inverter. Install according to the information in the Instruction Manual.
- Do not operate if the inverter is damaged or has parts missing.
- Do not hold the inverter by the front cover; it may fall off.
- Do not stand or rest heavy objects on the inverter.
- Check the inverter mounting orientation is correct.
- Prevent screws, wire fragments, conductive bodies, oil or other flammable substances from entering the inverter.
- Do not drop the inverter, or subject it to impact.
- Use the inverter under the following environmental conditions:

		Constant torque: -10°C to +40°C (14°F to 104°F) (non-freezing)		
	Ambient temperature	(-10°C to +30°C with FR-A5CV□□ attachment)		
		Variable torque: -10°C to +40°C (14°F to 104°F) (non-freezing)		
ent		(-10°C to +30°C with FR-A5CV□□ attachment)		
nn	Ambient humidity	90%RH or less (non-condensing)		
Environment	Storage temperature	-20°C to +65°C* (-4°F to 149°F)		
En	Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)		
		Maximum 1000m (3280.80 feet.) above sea level for standard operation.		
	Altitude, vibration	After that derate by 3% for every extra 500m up to 2500m (91%).		
		5.9 m/s ² {0.6G} or less (conforming to JIS C0911)		

^{*}Temperatures applicable for a short time, e.g. in transit.

(2) Wiring

! CAUTION

- Do not fit capacitive equipment such as a power factor correction capacitor, radio noise filter or surge suppressor to the output of the inverter.
- The connection orientation of the output cables U, V, W to the motor will affect the direction of rotation of the motor.

(3) Trial run

!CAUTION

• Check all parameters, and ensure that the machine will not be damaged by a sudden start-up.

(4) Operation

! CAUTION

- When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.
- The [STOP] key is valid only when the appropriate function setting has been made. Prepare an emergency stop switch separately.
- Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart
 the motor suddenly.

! CAUTION

- The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the equipment.
- The electronic over current protection does not guarantee protection of the motor from overheating.
- Do not use a magnetic contactor on the inverter input for frequent starting/stopping of the inverter.
- Use a noise filter to reduce the effect of electromagnetic interference. Otherwise nearby electronic equipment may be affected.
- Take measures to suppress harmonics. Otherwise power harmonics from the inverter may heat/damage the power capacitor and generator.
- When a 575V class motor is inverter-driven, it should be insulation-enhanced or surge voltages suppressed. Surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation.
- The inverter can be easily set for high-speed operation. Before changing its setting, examine the performance of the motor and machine.
- In addition to the inverter's holding function, install a holding device to ensure safety.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation.

(5) Emergency stop

CAUTION

 Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.

(6) Maintenance, inspection and parts replacement

/!\CAUTION

Do not carry out a megger (insulation resistance) test on the control circuit of the inverter.

(7) Disposing of the inverter

!CAUTION

Treat as industrial waste.

(8) General instructions

Many of the diagrams and drawings in this instruction manual show the inverter without a cover, or partially open. Never run the inverter like this. Always replace the cover and follow this instruction manual when operating the inverter.

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CHAPTER 1 OUTLINE

This chapter gives information on the basic "outline" of this product.

Always read the instructions in this chapter before using the equipment.

1.1 Pre-Operation Information	. 1
1.2 Basic Configuration	. 2
1.3 Structure	

<Abbreviations>

- Dl
 - Operation panel (FR-DU04)
- Pi
 - Operation panel (FR-DU04) and parameter unit (FR-PU04)
- Inverter
 - MGI inverter M4000 series
- Pr
 - Parameter number
- PU operation
 - Operation using the PU (FR-DU04/FR-PU04)
- External operation
 - Operation using the control circuit signals
- Combined operation
 Operation using both the PU (FR-DU04/FR-PU04) and external operation

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

1.1 Pre-Operation Information

OUTLINE

1.1.1 Precautions for operation

Incorrect handling might cause the inverter to operate improperly, its life to be reduced considerably, or at the worst, the inverter to be damaged. Handle the inverter properly in accordance with the information in each section as well as the precautions and instructions of this manual to use it correctly.

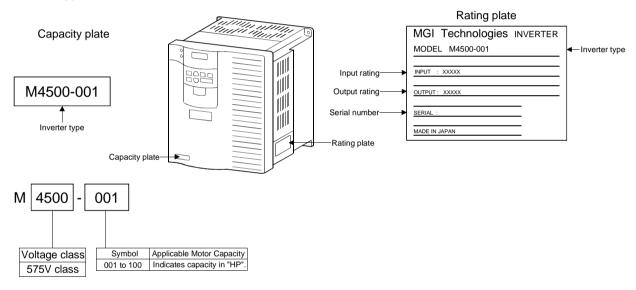
This manual is written for the M4000 series inverters.

For handling information on the parameter unit (FR-PU04), inboard options, stand-alone options, etc., refer to the corresponding manuals.

(1) Unpacking and product check

Unpack the inverter and check the capacity plate on the front cover and the rating plate on the inverter side face to ensure that the product agrees with your order and the inverter is intact.

1) Inverter type



2) Accessory

Instruction manual

If you have found any discrepancy, damage, etc., please contact your sales representative.

(2) Preparations of instruments and parts required for operation

Instruments and parts to be prepared depend on how the inverter is operated. Prepare equipment and parts as necessary. (Refer to page 35.)

(3) Installation

To operate the inverter with high performance for a long time, install the inverter in a proper place, in the correct direction, and with proper clearances. (Refer to page 7.)

(4) Wiring

Connect the power supply, motor and operation signals (control signals) to the terminal block. Note that incorrect connection may damage the inverter and peripheral devices. (See page 13.)

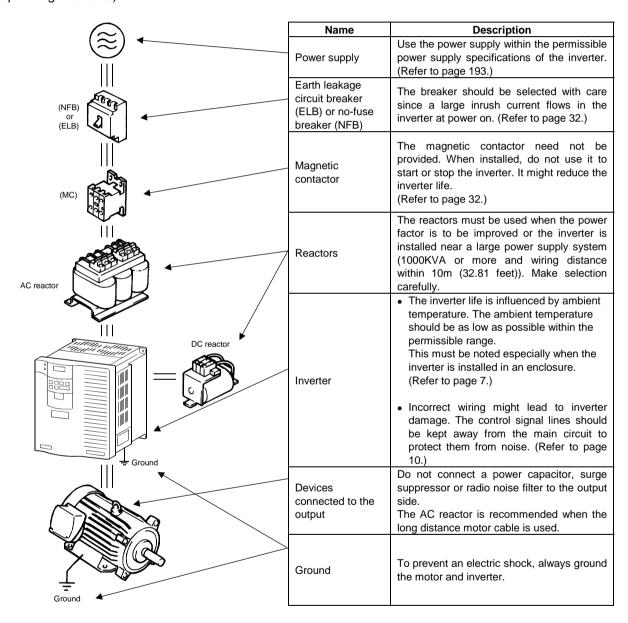
1.2 Basic Configuration

OUTLINE

1.2.1 Basic configuration

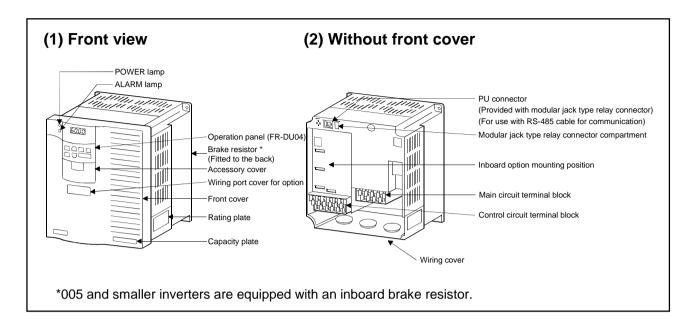
The following devices are required to operate the inverter. Proper peripheral devices must be selected and correct connections made to ensure proper operation. Incorrect system configuration and connections can cause the inverter to operate improperly, its life to be reduced considerably, and in the worst case, the inverter to be damaged.

Please handle the inverter properly in accordance with the information in each section as well as the precautions and instructions of this manual. (For connections of the peripheral devices, refer to the corresponding manuals.)



OUTLINE

1.3.1 Appearance and structure

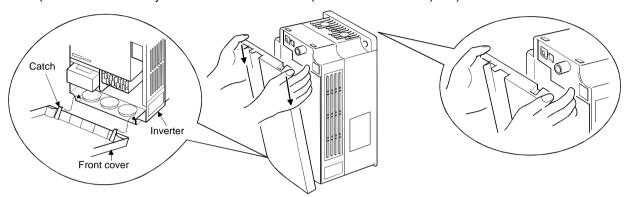


1.3.2 Removal and reinstallation of the front cover

M4500-001 to 010

Removal

- 1) Hold both sides of the front cover top and push the front cover down.
- 2) Hold down the front cover and pull it toward you to remove. (The front cover may be removed with the PU (FR-DU04/FR-PU04) on.)



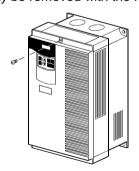
Reinstallation

- 1) Insert the catches at the bottom of the front cover into the sockets of the inverter.
- 2) Using the catches as supports, securely press the front cover against the inverter.

Note: When the operation panel is mounted and the front cover is removed, remove the operation panel before reinstalling the front cover.

M4500-025 / 040

- Removal
 - 1) Remove the installation screw at top of the front cover.
 - 2) Hold both ends of the front cover top.
 - 3) Pull the front cover toward you to remove. (The front cover may be removed with the PU (FR-DU04/FR-PU04) on.)





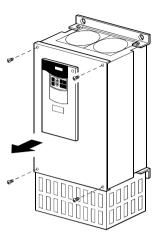
Reinstallation

- 1) Insert the catches at the front cover bottom into the sockets of the inverter.
- 2) Using the catches as supports, securely press the front cover against the inverter.
- 3) Fix the front cover with the top screw.

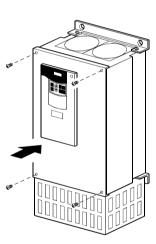
Note: When the operation panel is mounted on the front cover removed, remove the operation panel before reinstalling the front cover.

M4500-060 / 100

- Removal
 - 1) Remove the front cover mounting screws.



- Reinstallation
 - 1) Fix the front cover with the mounting screws.



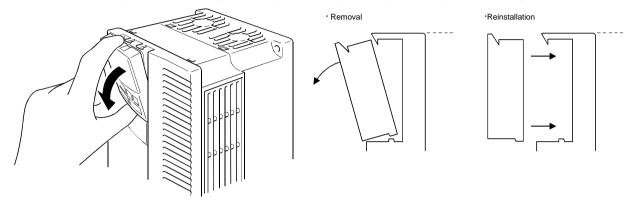
- Note: 1. Make sure that the front cover has been reinstalled securely.
 - 2. The same serial number is printed on the capacity plate of the front cover and the rating plate of the inverter. Before reinstalling the front cover, check the serial number to ensure that the cover removed is reinstalled to the inverter from where it was removed.

1.3.3 Removal and reinstallation of the operation panel

To ensure safety, remove and reinstall the operation panel after switching power off.

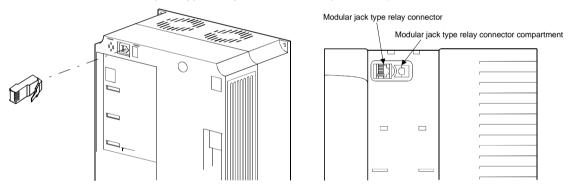
Removal

Hold down the top button of the operation panel and pull the operation panel toward you to remove.



To reinstall, insert straight and mount securely.

- Reinstallation using the connection cable
 - 1) Remove the operation panel.
 - 2) Disconnect the modular jack type relay connector. (Place the disconnected modular jack type relay connector in the modular jack type relay connector compartment.)



3) Securely plug one end of the connection cable into the PU connector (modular jack type relay connector) of the inverter and the other end into the operation panel.

Note: Install the operation panel only when the front cover is on the inverter.

MEMO

CHAPTER 2 INSTALLATION AND WIRING

This chapter gives information on the basic "installation and wiring" of this product.

Always read the instructions in this chapter before using the equipment.

2.1 Installation	7
2.2 Wiring	
2.3 Other wiring	27

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

2.1.1 Instructions for installation

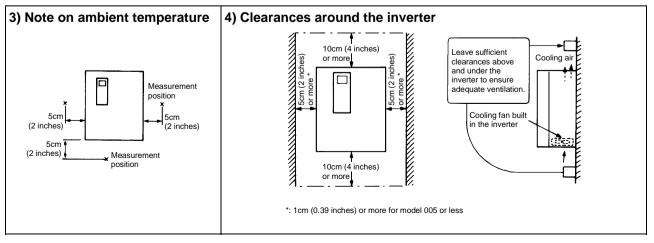
- 1) Handle the unit carefully.
 - The inverter uses plastic parts. Handle it gently to protect it from damage. Also, hold the unit with even strength and do not apply too much strength to the front cover alone.
- 2) Install the inverter in a place where it is immune to vibration. (5.9 m/s² {0.6G} or less) Also note the cart, press, etc.
- 3) Note on ambient temperature
 - The inverter life is under great influence of ambient temperature. In the place of installation, ambient temperature must be within the permissible range (depending upon the operation mode and conditions (see ambient temperature specifications on page 194). Check that the ambient temperature is within that range in the positions shown in figure 3).
- 4) Install the inverter on a non-combustible surface.

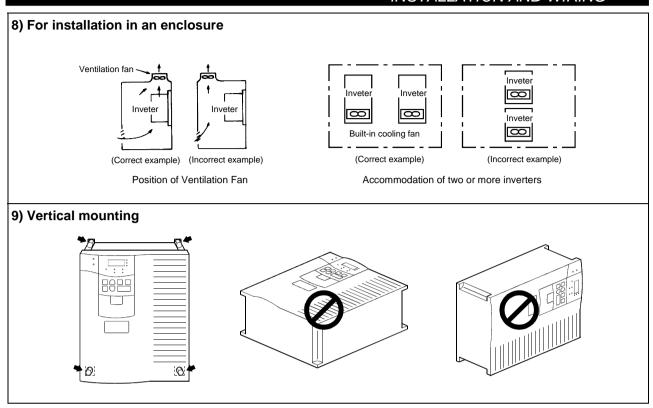
 The inverter will be very hot (maximum about 150°C). Install it on a non-combustible surface (e.g. metal).

 Also leave sufficient clearances around the inverter.
- 5) Avoid high temperature and high humidity.

 Avoid direct sunlight and places of high temperature and high humidity.
- 6) The amount of heat generated in an enclosure can be reduced considerably by placing the heat sink outside the enclosure.
- Note: 1. Use the option (FR-A5CN□□) for installation. The mounting area should be cut to the panel cutting dimensions.
 - 2. The cooling section outside the enclosure has the cooling fan. Do not use the inverter in any environment where it is exposed to water drops, oil mist, dust, etc.
 - 3. The cable conduit attachment packed with the 060 or 100 is not necessary.
- 7) Avoid places where the inverter is exposed to oil mist, flammable gases, fluff, dust, dirt etc. Install the inverter in a clean place or inside a "totally enclosed" panel which does not accept any suspended matter.
- 8) Note the cooling method when the inverter is installed in an enclosure.

 When two or more inverters are installed or a ventilation fan is mounted in an enclosure, the inverters and ventilation fan must be installed in proper positions with extreme care taken to keep the ambient temperatures of the inverters below the permissible value. If they are installed in improper positions, the ambient temperatures of the inverters will rise and ventilation effect will be reduced.
- 9) Install the inverter securely with screws or bolts in the vertical direction.

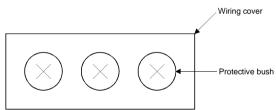




(1) Wiring cover and handling

1) When cable conduits are not connected

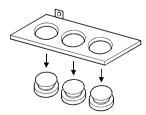
Cut the protective bushes of the wiring cover with nippers or a cutter before running the cables.



MARNING

Do not remove the protective bushes. Otherwise, the cable sheathes may be scratched by the wiring cover edges, resulting in a short circuit or ground fault.

2) When cable conduits are connected Remove the corresponding protective bushes and connect the cable conduits.



(2) Installation of attachment for conduit connection (060, 100)

An attachment for conduit connection is a standard accessory for models M4500-060 and M4500-100. It is shipped together with the inverter in one crate. If the inverter is not installed inside an electrical enclosure, mount this attachment according to the below instructions. If the inverter is mounted inside an electrical enclosure and conduit is not used, it is not necessary to use this attachment.

1) Preparation

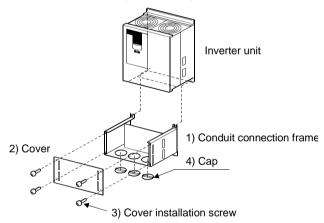
confirm that the following parts are enclosed with the indicated quantity.

No. Name		Quantity
1 Conduit connection frame		1
2 Cover		1
3 Cover installation screw		4 (M4)
4 Cap		3

2) Installation

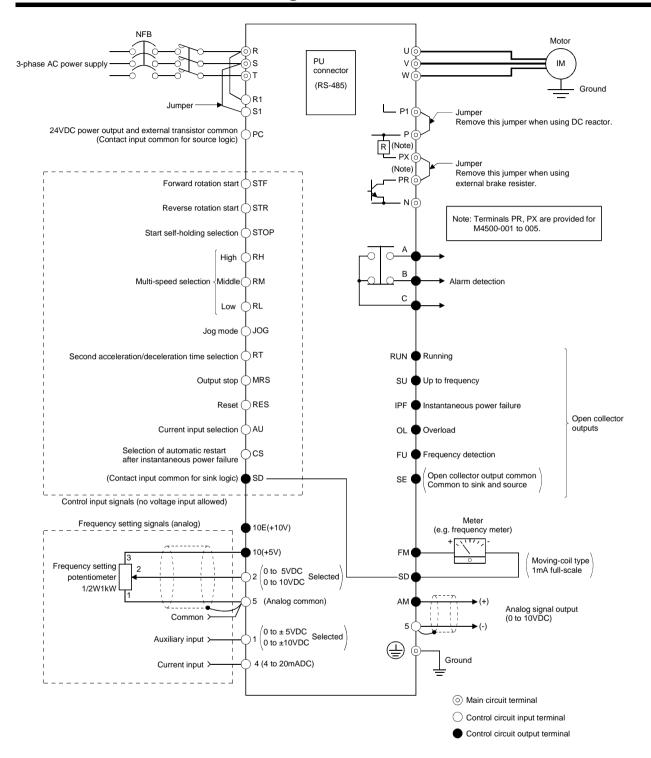
- (a) Fix with the two installation screws (combined tightening) at the bottom of the inverter unit and the two screws at the bottom of the attachment.
- (b) Install caps on the holes through which wires are not passed.

 After installing the cap, bend the metal clasps to fix in position.



Note: To extend the heat-sink of 060 and 100 models through the back of an enclosure, an adapter model no. FR-A5CN06 must be used, and it is not possible to use the conduit connection attachment.

2.2.1 Terminal connection diagram



(1) Description of main circuit terminals

Symbol Terminal Name		Description	
R, S, T	AC power input	Connect to the commercial power supply.	
U, V, W	Inverter output	Connect a three-phase squirrel-cage motor.	
R1, S1	Power supply for control circuit	Connected to the AC power supply terminals R and S. To retain the alarm display and alarm output, remove the jumpers from terminals R-R1 and S-S1 and apply external power to these terminals.	
P, PR	Brake resistor connection	Disconnect the jumper from terminals PR-PX and connect the external brake resistor across terminals P-PR. (Provided for 010 or less.)	
P, P1	Power factor improving DC reactor connection	Disconnect the jumper from terminals P-P1 and connect the DC reactor.	
PR, PX Built-in brake circuit connection When the jumper is connected across terminals PX-PR (factory set the built-in brake circuit is valid. (Provided for 010 or less. 010 does not have the built-in brake resistor and the jumper.)		(Provided for 010 or less.	
	Ground	For grounding the inverter chassis. Must be earthed.	

(2) Description of control circuit terminals

Ту	ре	Symbol	Terminal Name Description		
		STF	Forward rotation start	Turn on the STF signal to start forward rotation and turn it off to stop. Acts as a programmed operation start signal in the programmed operation mode. (Turn on to start and turn off to stop.)	When the STF and STR signals are turned on simultaneously,
		STR	Reverse rotation start	Turn on the STR signal to start reverse rotation and turn it off to stop.	the stop command is given.
		STOP	Start self-holding selection	Turn on the STOP signal to select the self-holding of the start sign	al.
		RH, RM, RL	Multi-speed selection	Use the RH, RM and RL signals as appropriate to select multiple speeds.	
	stop (STOP) etc.	JOG	JOG mode selection	Turn on the JOG signal to select jog operation (factory setting). Jog operation can be performed with the start signal (STF or STR).	Input terminal function selection (Pr. 180 to
Input signals	start (STF), stop (ST	RT	Second acceleration/ deceleration time selection	Turn on the RT signal to select the second acceleration/ deceleration time. When the second functions such as "second torque boost" and "second V/F (base frequency)" functions have been set, these functions can also be selected by turning on the RT signal.	Pr. 186) change terminal functions.
Input		MRS	Output stop	Turn on the MRS signal (20ms or longer) to stop the inverter output Used to shut off the inverter output to bring the motor to a stop by brake.	
	Contacts, e.g.	RES	Reset	Used to reset the protective circuit activated. Turn on the RES sign 0.1 second, then turn it off.	nal for more than
		AU	Current input selection	Only when the AU signal is turned on, the inverter can be operated with the 4-20mADC frequency setting signal.	Input terminal function selection
		CS	Automatic restart after instantaneous power failure selection	With the CS signal on, restart can be made automatically when the power is restored after an instantaneous power failure. Note that this operation requires restart parameters to be set. When the inverter is shipped from the factory, it is set to disallow restart.	(Pr. 180 to Pr. 186) change terminal functions.
		SD	Contact input common (sink)	Common to the contact input terminals and terminal FM. Common 24VDC 0.1A power (PC terminal).	output terminal for
		PC	24VDC power and external transistor common Contact input common (source)	When transistor output (open collector output), such as a program connected, connect the external power supply common for transist terminal to prevent a fault caused by leakage current. This termina 24VDC, 0.1A power output. When source logic has been selected, serves as a contact input common.	tor output to this

Ту	ре	Symbol	Terminal Name		Description		
		10E		10VDC, permissible load	When the frequency setting pote		
Input signals		102	102	Frequency setting	current 10mA	connected in the factory-set state	e, connect it to
		10	power supply	5VDC, permissible load current 10mA	terminal 10. When it is connected to terminal input specifications of terminal 2.		
	Analog frequency setting	2	Frequency setting (voltage)	(or 10V) and I/O are proportional and 0 to 10VDC from the operation permissible voltage 20V.	DC), the maximum output frequen . Switch between input 0 to 5VDC on panel. Input resistance $10k\Omega$. I	(factory setting) Maximum	
	log frequ	4	Frequency setting (current)		aximum output frequency is reach ignal is valid only when the AU signissible current 30mA.		
	Ana	1	Auxiliary frequency setting	By entering 0 to ± 5 VDC 0 to ± 10 VDC, this signal is added to the frequency signal of terminal 2 or 4. Switch between input 0 to ± 5 VDC and 0 to ± 10 VDC setting) from the operation panel. Input resistance $10k\Omega$. Maximum permiss voltage ± 20 V.		o ±10VDC (factory	
		5	Frequency setting input common	terminal AM. Do not earth.	g signal (terminal 2, 1 or 4) and an	nalog output	
	Contact	A, B, C	Alarm output	Change-over contact output indicating that the output has been stopped by the inverter protective function activated. 200VAC 0.3A, 30VDC 0.3A. Alarm: discontinuity across B-C (continuity across A-C), normal: continuity across B-C (discontinuity across A-C).			
	Open collector	RUN	Inverter running	Switched high during stop or DC Permissible load 24VDC 0.1A.	y (factory set to 0.5Hz, variable). dynamic brake operation (*2).	Output terminal function selection (Pr. 190 to Pr. 195) change terminal functions.	
		SU	Up to frequency	Switched low when the output free ±10% of the set frequency (factor high during acceleration, deceler load 24VDC 0.1A.	ry setting, variable). Switched		
Output signals		OL	Overload alarm	Switched low when the stall prev prevention to be activated. Switch reset (*2). Permissible load 24VI	hed high when stall prevention is		
utput		IPF	Instantaneous power failure	Switched low when instantaneou protection is activated (*2). Perm			
0		FU	Frequency detection	Switched low when the output fre exceeded the detection frequenchigh when below the detection frequency 24VDC 0.1A	y set as appropriate. Switched		
		SE	Open collector output common	Common to the RUN, SU, OL, IF			
	Pulse	FM	For meter	One selected from 16 monitoring items, such as output frequency, is output. (*3)	Factory setting of output item: Frequency Permissible load curi 1440 pulses/second		
	Analog	АМ	Analog signal output	The output signal is proportional to the magnitude of each monitoring item.	Factory setting of output item: Frequency Output signal 0 to 10 Permissible load curr		
Communication	RS-485	—	PU connector	With the operation panel connector, communication can be made through RS-485. Conforming Standard: EIA Standard RS-485. Transmission format: Multi-drop link. Communication speed: Maximum 19200 baud rates. Overall length: 500m			

^{*1:} Terminals PR and PX are provided for the M4500-001 to 010

^{*2:} Low indicates that the open collector outputting transistor is on (conducts). High indicates that the transistor is off (does not conduct).

^{*3:} Not output while the inverter is reset.

2.2.2 Wiring of the main circuit

(1) Wiring instructions

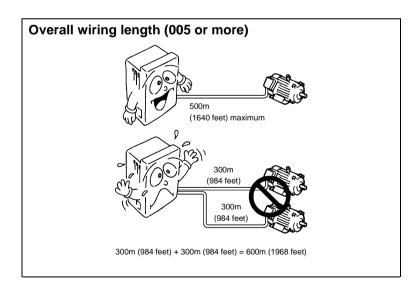
- 1) Crimping terminals with insulation sleeves are recommended for use with the power and motor cables.
- 2) Cut the protective bushes of the wiring cover when running the cables.
- 3) Power must not be applied to the output terminals (U, V, W) of the inverter. Otherwise the inverter will be damaged.
- 4) After wiring, wire off-cuts must not be left in the inverter. Wire off-cuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in a control box etc., exercise care to prevent chips and other foreign matter from entering the inverter.
- 5) Use cables of the recommended size for wiring to make the voltage drop 2% or less.

 If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease especially at the output of a low frequency.
- 6) The overall wiring length should be 500m (1640.40feet) maximum. Especially for long distance wiring, the fast-response current limit may be misactivated under the influence of a charging current due to the stray capacitance of the wiring. The fast-response current limit must be turn off by Pr.156 when the total wiring length is more than the indicated value in the following table for M4500-010 to 005.

Inverter Model	001	003	005
Non-low acoustic noise mode	100m (328 feet)	300m (984 feet)	300m (984 feet)
Low acoustic noise mode	100m (328 feet)	200m (656 feet)	300m (984 feet)

Even though the fast-response current limit is turned off, in more long distance wiring situations the over current protection may be misactivated or the devices connected to the output side may misoperate or become faulty under the influence of a charging current due to the stray capacitance of the wiring. Therefore, the maximum overall wiring length should be as indicated in the following table. (When two or more motors are connected to the inverter, the total wiring length should be within the indicated value.)

Inverter Model	001	003	005 or more	
Total wiring length	100m (328 feet)	300m (984 feet)	500m (1640 feet)	



7) Connect only the recommended external brake resistor between the terminals P and PR. These terminals must not be shorted.

- 8) Electromagnetic wave interference
 - The input/output (main circuit) of the inverter includes harmonic components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, install FR-BSF01 or FR-BLF line noise filter to minimize interference.
- 9) Do not install a power capacitor, surge suppressor in the output side of the inverter. This will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices are installed, immediately remove them. (If capacitor type filter is connected, switching power off during motor operation may result in E.UVT. In this case, connect the capacitor type filter in the primary side of the electromagnetic contactor.)
- 10) When rewiring after operation, make sure that the POWER lamp has gone off, and when more than 10 minutes have elapsed after power-off, check with a meter that the voltage is zero. After that, start rewiring work. For some time after power-off, there is a dangerous voltage in the capacitor.

!CAUTION

Do not use residual current protective device as the only protection against indirect contact.

Protective earth connection essential.

1 Do not connect more than 2 wires on the protective earth terminal.

Notes on Grounding

- Leakage currents flow in the inverter. To prevent an electric shock, the inverter and motor must be grounded.
- Use the dedicated ground terminal to ground the inverter. (Do not use the screw in the case, chassis, etc.)
- The ground cable should be as thick as possible.
 Its gauge should be equal to or larger than those indicated in the following table. The grounding point should be as near as possible to the inverter to minimize the ground cable length.
- Ground the motor on the inverter side using one 55kW (75HP)
 wire of the 4-core cable.

 (Unit: mm²)

 Motor Capacity
 Ground Cable Gauge

 3.7kW (5HP) or less
 3.5

 7.5kW (10HP)
 5.5

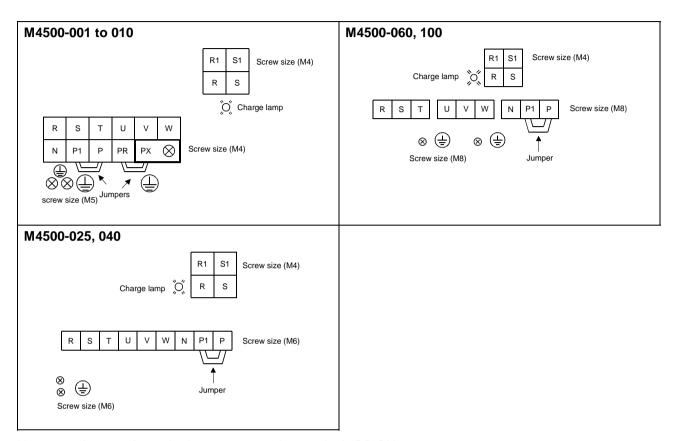
 15kW (20HP)
 14

 22 kW (30HP), 37kW (50HP)
 22

 55kW (75HP)
 38

(2) Terminal block layout

In the main circuit of the inverter, the terminals are arranged as shown below:



Note: 010 does not have the jumper across the terminals PR-PX.

(3) Cables, crimping terminals, etc.

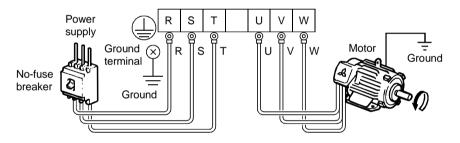
The following table lists the cables and crimping terminals used with the inputs (R, S, T) and outputs (U, V, W) of the inverter and the torque for tightening the screws:

11	Tamainal	Terminal Tightening Torque Screw Size N⋅m (Kgf⋅c m)	Crimping Terminals		Cables (Note 1)			
					mm²		AWG	
	ociew oize		R, S, T	U, V, W	R, S, T	U, V, W	R, S, T	U, V, W
M4500-001								
-003	M4	1 (15)	2-4	2-4	2	2	14	14
-005								
M4500-010	M4	1 (15)	5.5-4	2-4	3.5	2	12	14
M4500-025	M6	4 (45)	5.5-6	5.5-6	5.5	5.5	10	10
M4500-040	M6	4 (45)	14-6	14-6	14	14	6	6
M4500-060	M8	7 (80)	22-8	22-8	22	22	4	4
M4500-100	M8	7 (80)	38-8	38-8	38	38	2	2

Note: 1. The cables used should be 75°C (167°F) copper cables.

Tighten the terminal screws to the specified torque.
 Undertightening can cause a short or misoperation.
 Overtightening can cause the screws and unit to be damaged, resulting in a short or misoperation.

(4) Connection of the power supply and motor



The power supply cables must be connected to R, S, T. If they are connected to U, V, W, the inverter will be damaged. Phase sequence need not be matched.

For use with a single-phase power supply,the power supply cables must be connected to R and S.

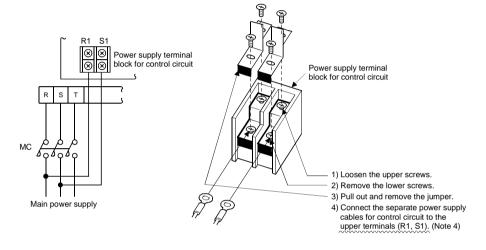
Connect the motor to U, V, W. In the above connection, turning on the forward rotation switch (signal) rotates the motor in the counterclockwise (arrow) direction when viewed from the load shaft.

(5) Connecting the control circuit to a power supply separately from the main circuit

If the magnetic contactor (MC) in the inverter power supply is opened when the protective circuit is operated, the inverter control circuit power is lost and the alarm output signal cannot be kept on. To keep the alarm signal on terminals R1 and S1 are available. In this case, connect the power supply terminals R1 and S1 of the control circuit to the primary side of the MC.

Model M4500-001 to 100

<Connection procedure>



- Note: 1. When the main circuit power (R, S, T) is on, do not switch off the control power (terminals R1, S1). Otherwise the inverter may be damaged.
 - 2. When using a separate power supply, the jumpers across R-R1 and S-S1 must be removed. Otherwise the inverter may be damaged.
 - 3. For a different power supply system which takes the power of the control circuit from other than the primary side of the MC, the voltage should be equal to the main circuit voltage.
 - 4. The power supply cables must not be connected to the lower terminals. If connected, the inverter may be damaged.
 - 5. Entering the start signal with power supplied to only the R1 and S1 terminals will result in an error display (E.OC1).

2

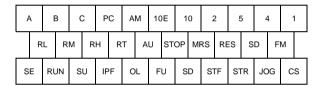
2.2.3 Wiring of the control circuit

(1) Wiring instructions

- 1) Terminals SD, SE and 5 are common to the I/O signals and isolated from each other. These common terminals must not be connected to each other or earthed.
- 2) Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit).
- 3) The frequency input signals to the control circuit are micro currents. When contacts are required, use two or more parallel micro signal contacts or a twin contact to prevent a contact fault.
- 4) It is recommended to use the cables of 0.75mm² gauge for connection to the control circuit terminals. If the cable gauge used is 1.25mm² or more, the front cover may be lifted when there are many cables running or the cables are run improperly, resulting in an operation panel or parameter unit contact fault.

(2) Terminal block layout

In the control circuit of the inverter, the terminals are arranged as shown below: Terminal screw size: M3.5



(3) Changing the control logic

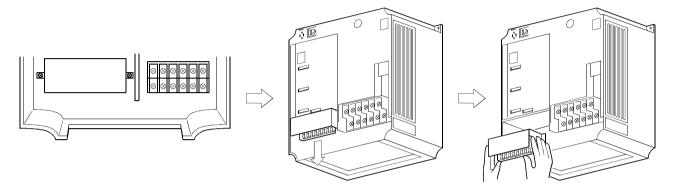
The input signal logic is factory-set to the sink mode.

To change the control logic, the connector on the back of the control circuit terminal block must be moved to the other position.

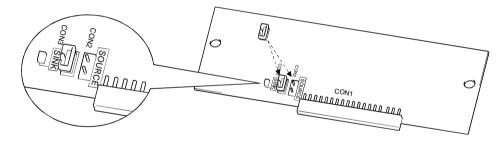
(The output signals may be used in either the sink or source logic independently of the connector position.)

1) Loosen the two mounting screws in both ends of the control circuit terminal block. (The screws cannot be removed.)

With both hands, pull down the terminal block from the back of the control circuit terminals.



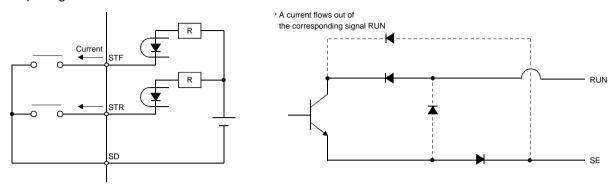
2) Remove the connector from the rear surface of the control circuit terminal block and place in required Logic position (either Sink or Source).



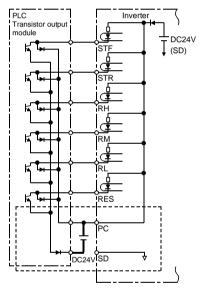
- 3) Using care not to bend the pins of the control circuit connector, reinstall the control circuit terminal block and fix it with the mounting screws.
 - Note: 1. Make sure that the control circuit connector is fitted correctly.
 - 2. While power is on, never disconnect the control circuit terminal block.
 - 3. The sink-source logic change-over connector must be fitted in only one of those positions. If it is fitted in both positions at the same time, the inverter may be damaged.

4) Sink logic type

• In this logic, a signal switches on when a current flows out of the corresponding signal input terminal. Terminal SD is common to the contact input signals. Terminal SE is common to the open collector output signals.

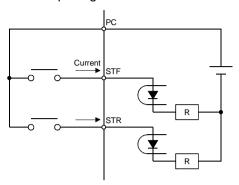


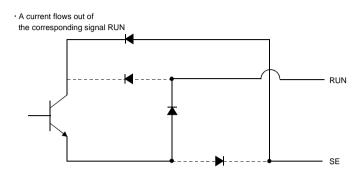
• When using an external power supply for transistor output, use terminal PC as a common to prevent misoperation caused by leakage current. (Do not connect terminal SD of the inverter with terminal 0V of the external power supply.)



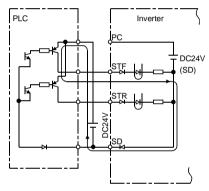
5) Source logic type

• In this logic, a signal switches on when a current flows into the corresponding signal input terminal. Terminal PC is common to the contact input signals. Terminal SE is common to the open collector output signals.





• When using an external power supply for transistor output, use terminal SD as a common to prevent misoperation caused by leakage current.



(4) How to use terminals "STOP", "CS" and "PC"

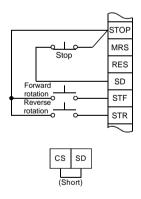
1) Using the "STOP" terminal

A connection example (for sink logic) for self-holding the start signal (forward rotation, reverse rotation) is shown on the right.

2) Using the "CS" terminal

This terminal is used to perform automatic restart after instantaneous power failure and commercial power supply-inverter switch-over operation.

Example: Automatic restart after instantaneous power failure in sink logic>Connect terminals CS-SD and set a value other than "9999" in Pr. 57 "coasting time for automatic restart after instantaneous power failure".



3) Using the "PC" terminal

This terminal can be used as 24VDC power output using SD as a common terminal.

Specifications: 18V to 26VDC, 0.1A permissible current

Note that the wiring length should be within 30m.

Do not short terminals PC-SD.

When terminal PC is used as a 24V power supply, leakage current from transistor output cannot be prevented.

9

2.2.4 Connection to the PU connector

(1) When connecting the operation panel or parameter unit using a connection cable

<Recommended cable connector>

- Parameter unit connection cable (FR-CB2) (option) or the following connector and cable.
- Connector: RJ45 connector

Example: 5-554720-3, Nippon AMP

• Cable: Cable conforming to EIA568 (e.g. 10BASE-T cable)

Example: SGLPEV 0.5mm×4P, MITSUBISHI CABLE INDUSTRIES, LTD.

Note: The maximum wiring length is 20m (65.62 feet).

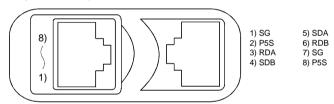
(2) For RS-485 communication

With the operation panel disconnected, the PU connector can be used for communication operation from a personal computer etc.

When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program allows the inverter to be run and monitored and the parameter values to be read and written.

<PU connector pin-outs>

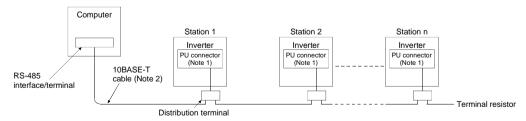
Viewed from the inverter (receptacle side) front



- Note: 1. Do not connect the PU connector to the computer's LAN board, FAX modem socket or telephone modular connector. Otherwise, the product may be damaged due to electrical specification differences.
 - 2. Pins 2) and 8) (P5S) provide power to the operation unit or parameter unit. Do not use these pins for RS-485 communication.

<System configuration example>

1) When a computer having a RS-485 interface is used with several inverters



Use the connector and cables which are available on the market.

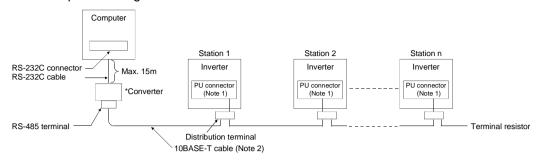
Note: 1. Connector: RJ45 connector

Example: 5-554720-3, Nippon AMP Co., Ltd.

2. Cable: Cable conforming to EIA568B (such as 10BASE-T cable)

Example: SGLPEV 0.5mm×4P, Mitsubishi Cable Industries, Ltd.

2) When a computer having a RS-232C interface is used with inverters



*Converter available on the market is required. (Note 3)

Use the connector, cables and converter, which are available on the market.

Note: 1. Connector: RJ45 connector

Example: 5-554720-3, Nippon AMP Co., Ltd.

2. Cable: Cable conforming to EIA568B (such as 10BASE-T cable)

Example: SGLPEV 0.5mm×4P, Mitsubishi Cable Industries, Ltd.

3. *Commercially available converter examples:

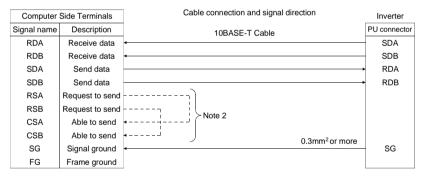
Model: FA-T-RS40

Converter

Industrial System Division., Mitsubishi Electric Engineering Co., Ltd.

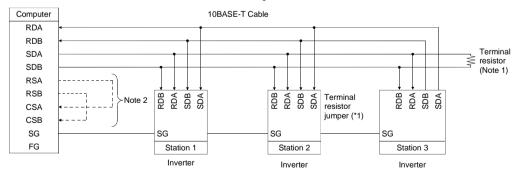
<Wiring method>

1) Wiring of one RS-485 computer and one inverter



2) Wiring of one RS-485 computer and "n" inverters (several inverters)

Cable connection and signal direction



- Note: 1. There may be the influence of reflection depending on the transmission speed and/or transmission distance. If this reflection hinders communication, provide a terminal resistor. If the PU connector is used to make a connection, use a distributor as a terminal resistor cannot be fitted. Connect the terminal resistor only to the inverter remotest from the computer.(Terminal resistor: $100~\Omega$)
 - Make connections in accordance with the instruction manual of the computer used. Fully check the terminal numbers of the computer as they differ between models.

2.2.5 Connection of brake resistor and DC reactor

Incorrect connection will cause inverter damage or accident.

(1) Connection of the external brake resistor (010 or less)

The built-in brake resistor is connected across terminals P and PR. Fit the external brake resistor instead when the built-in brake resistor does not have enough thermal capability for high-duty operation. Remove the jumper from across terminals PR-PX and connect the external brake resistor across terminals P-PR. (For the positions of terminals P and PR, refer to the terminal block arrangement (page15).)

The external brake resistor should be as listed in the following table. Selected the rated power of the brake resistor according to the brake duty. (The rated power indicated below assumes that the brake resistor duty is 10%)

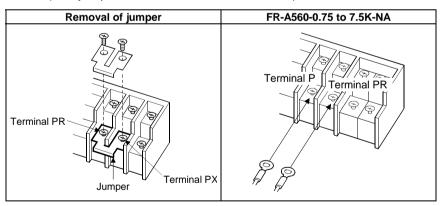
Inverter size	Brake resistance	Reference rated power at brake duty of 10%	
0.75K	1000 ohm minimum	180W minimum	
2.2K	350 ohm minimum	500W minimum	
3.7K	200 ohm minimum	800W minimum	
7.5K	110 ohm minimum	1600W minimum	

Note: 1. The brake resistor connected should only be the dedicated brake resistor.

- 2. The jumper across terminals PR-PX must be disconnected before connecting the dedicated brake resistor. A failure to do so may damage the inverter.
- 3. The 010 model does not have the built-in brake resistor and the jumper across terminals PR-PX.

ModelM4500-001 to 010

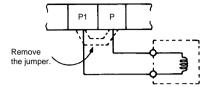
- 1) Remove the screws in terminals PR and PX and remove the jumper.
- 2) Connect the brake resistor across terminals P-PR. (The jumper should remain disconnected.)



INSTALLATION AND WIRING

(2) Connection of the power factor improving DC reactor

Connect the power factor improving DC reactor <Connection method> between terminals P1-P. In this case, the jumper connected across terminals P1-P must be removed. Otherwise, the reactor will not function.

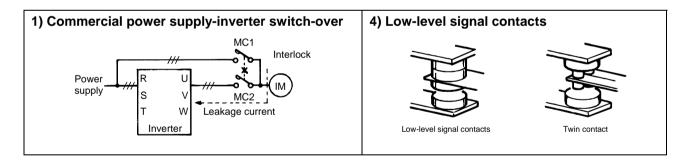


Note: 1. The wiring distance should be within 5m.

2. The size of the cables used should be equal to or larger than that of the power supply cables

2.2.6 Design information

- 1) For commercial power supply-inverter switch-over operation, provide electrical and mechanical interlocks for MC1 and MC2 designed for commercial power supply-inverter switch-over. When there is a commercial power supply-inverter switch-over circuit as shown below, the inverter will be damaged by leakage current from the power supply due to arcs generated at the time of switch-over or chattering caused by a sequence error.
- 2) If the machine must not be restarted when power is restored after a power failure, provide a magnetic contactor in the inverter's primary circuit and also make up a sequence which will not switch on the start signal.
 - If the start signal (start switch) remains on after a power failure, the inverter will automatically restart as soon as the power is restored.
- 3) When the power supply used with the control circuit is different from the one used with the main circuit, make up a circuit which will switch off the main circuit power supply terminals R, S, T when the power supply terminals R1, S1 for the control circuit are switched off.
- 4) Since the input signals to the control circuit are on a low level, use two parallel micro signal contacts or a twin contact for contact inputs to prevent a contact fault.
- 5) Do not apply a large voltage to the contact input terminals (e.g. STF) of the control circuit.
- 6) Do not apply a voltage directly to the alarm output signal terminals (A, B, C). Always apply a voltage to these terminals via a relay coil, lamp, etc.
- 7) Make sure that the specifications and rating match the system requirements.

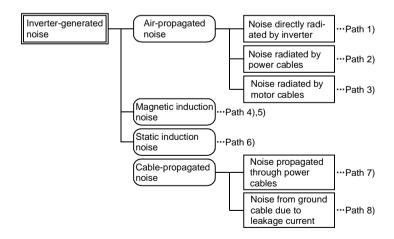


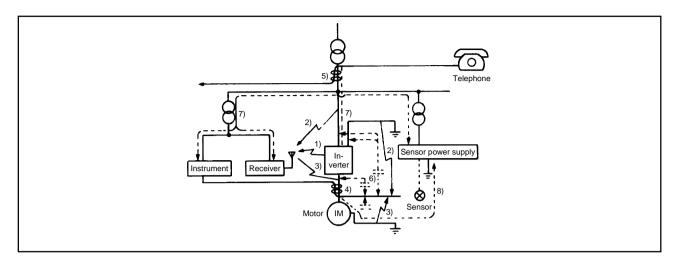
2.3.1 Inverter-generated noises and reduction techniques

Some noises enter the inverter causing it to misoperate and others are radiated by the inverter causing misoperation of peripheral devices. Though the inverter is designed to be insusceptible to noise, it handles low-level signals, so it requires the following basic measures to be taken. Also, since the inverter chops the output at a high carrier frequency, it could generate noise. If these noises cause peripheral devices to misoperate, measures should be taken to suppress the noise. The measures differ slightly depending on noise propagation paths.

1) Basic measures

- Do not run the power cables (I/O cables) and signal cables of the inverter in parallel with each other and do not bundle them.
- Use twisted shielded cables for the detector connection and control signal cables and connect the sheathes of the shielded cables to terminal SD.
- Ground the inverter, motor, etc. at one point.
- 2) Measures against noises which enter and cause misoperation of the inverter When devices which generate many noises (which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the inverter and the inverter may be effected by noise, the following measures must be taken:
 - Provide surge suppressors for devices that generate noise to suppress noise.
 - Fit data line filters (refer to page 29) to signal cables.
 - Ground the shields of the detector connection and control signal cables with cable clamp metal.
- 3) Measures against noise which is radiated by the inverter causing misoperation of peripheral devices. Inverter-generated noise is largely classified into those radiated by the cables connected to the inverter and inverter main circuit (I/O), those electromagnetically and electrostatically inducted to the signal cables of the peripheral devices close to the main circuit power supply, and those transmitted through the power supply cables.





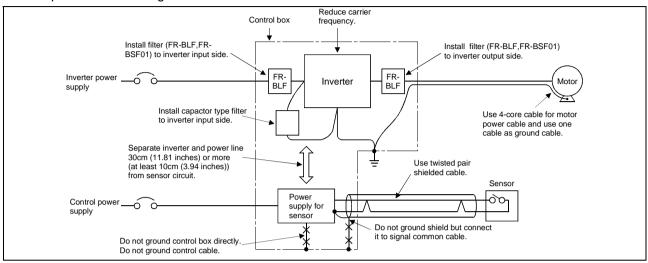
Noise Path	Measures	
1) 2) 3)	When devices which handle low-level signals and are susceptible to misoperation due to noise (such as instruments, receivers and sensors) are installed near the inverter and their signal cables are contained in the same panel as the inverter or are run near the inverter, the devices may be effected by air-propagated noises and the following measures must be taken: (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible from the inverter. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) Inset line noise filters into I/O and capacitor type filter into input side to suppress cable-radiated noises. (5) Use shielded cables for signal cables and power cables and run them in individual metal conduits to reduce further effects.	
4) 5) 6)	When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noise may be propagated to the signal cables to effect the devices and the following measures must be taken: (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible form the inverter. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) Use shield cables for signal cables and power cables and run them in individual metal conduits to reduce further effects.	
7)	When the power supplies of the peripheral devices are connected to the power supply of the inverter within the same line, inverter-generated noise may flow back through the power supply cables to misoperate the devices and the following measures must be taken: (1) Install the capacitor type filter to the power cables (I/O cables) of the inverter. (2) Install the line noise filter (FR-BLF, FR-BSF01) to the power cables (I/O cables) of the inverter.	
8)	When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage current may flow through the ground cable of the inverter to effect the device. In such a case, disconnection of the ground cable of the device may cause the device to operate properly.	

INSTALLATION AND WIRING

• Data line filter

Noise entry can be prevented by providing a data line filter for the detector cable etc.

• Example of measures against noises



2.3.2 Leakage currents and countermeasures

Due to the static capacitance existing in the inverter I/O wiring and motor, leakage currents flow through them. Since their values depend on the static capacitance, carrier frequency, etc., take the following measures.

(1) To-ground leakage currents

Leakage currents may flow not only into the inverter's own line but also into the other line through the ground cable, etc. These leakage currents may operate earth leakage circuit breakers and earth leakage relays unnecessarily.

Countermeasures

- Decrease the carrier frequency (Pr. 72) of the inverter.
 Note that motor noise increases. Selection of Soft-PWM (Pr. 240) will make it unoffending.
- By using earth leakage circuit breakers designed for harmonics and surges (e.g. Mitsubishi's Progressive Super Series) in the inverter's own line and other line, operation can be performed with low noise (with the carrier frequency kept high)

• To-ground leakage current

- Note that a long wiring length will increase leakage currents. Decrease the carrier frequency of the inverter to reduce leakage currents.
- Higher motor capacity leads to larger leakage currents. Larger leakage currents occur in 575V class than in 200V and 400V class.

(2) Line-to-line leakage currents

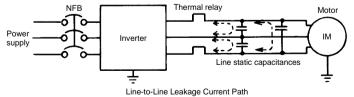
Harmonics of leakage currents flowing in static capacities between the inverter output cables may operate the external thermal relay unnecessarily. When the wiring length is long (50m (164.04 feet) or more) for the small-capacity model (7.5kW (10HP) or less), the external thermal relay is likely to operate unnecessarily because the ratio of the leakage current to the rated motor current increases.

• Line-to-Line Leakage Current Data Example

Motor Consoity	Rated Motor	Leakage Current (mA)		
Motor Capacity (kW (HP))	Current (A)	Wiring length 50m (164.04 feet)	Wiring length 100m (328.08 feet)	
0.4 (1/2)	1.8	930	1500	
0.75 (1)	3.2	1020	1590	
1.5 (2)	5.8	1110	1680	
2.2 (3)	8.1	1200	1770	
3.7 (5)	12.8	1320	1890	
5.5 (7.5)	19.4	1470	2040	
7.5 (10)	25.6	1605	2175	

Motor: Mitsubishi Electric SF-JR 4P Carrier frequency: 14.5Hz Cable used: 2mm² 4-core

cable



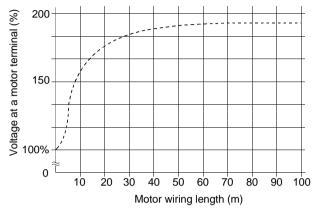
• Countermeasures

- Use the electronic overcurrent protection (Pr. 9) of the inverter.
- Decrease the carrier frequency. Note that motor noise increases. Selection of Soft-PWM (Pr. 240) will make it unoffending.

To ensure that the motor is protected against line-to-line leakage currents, it is recommended to use a temperature sensor to directly detect motor temperature.

2.3.3 Inverter-driven 575V class motor

In the PWM type inverter, a surge voltage attributable to wiring constants is generated at the motor terminals. Especially for a 575V class motor, the surge voltage may deteriorate the insulation.



Surge voltage at a motor terminal by motor wiring length (reference)

When the 575V class motor is driven by the inverter, consider the following measures:

- Measures
- (1) Inverter duty motor

Select an inverter duty motor. Many motor manufacturers sell motors with insulation systems designed to withstand the stress imposed by PWM inverters.

(2) AC reactor

For added protection, install an AC reactor on the inverter output.

2.3.4 Peripheral devices

(1) Selection of peripheral devices

Check the capacity of the motor to be used with the inverter you purchased. Appropriate peripheral devices must be selected according to the capacity.

Refer to the following list and prepare appropriate peripheral devices:

Invertor Type	Motor	Power Supply	Rated current of No-Fuse Breaker or Earth Leakage Circuit Breaker		Magnetic Contactor
Inverter Type	Output (kW (HP))	Capacity (kVA)	Standard	With power factor improving reactor	(AC3)
M4500-001	0.75 (1)	2.5	5A	5A	3A
M4500-003	2.2 (3)	5.5	15A	10A	7A
M4500-005	3.7 (5)	9	20A	15A	10A
M4500-010	5.5 (7.5)	12	30A	20A	15A
M4500-010	7.5 (10)	17	30A	30A	21A
M4500-025	11 (15)	20	50A	40A	31A
M4500-025	15 (20)	28	60A	50A	42A
M4500-040	18.5 (25)	34	75A	60A	50A
M4500-040	22 (30)	41	90A	75A	59A
M4500-060	30 (40)	52	125A	100A	78A
M4500-060	37 (50)	66	150A	125A	94A
M4500-100	55 (75)	100	200A	175A	137A

Notice: For installations in the United States, branch circuit protection must be provided in accordance with the National Electrical Code and any applicable local codes.

For installations in Canada, branch circuit protection must be provided in accordance with the Canadian Electrical Code and any applicable provincial codes.

(2) Selection the rated sensitivity current for the earth leakage circuit breaker

When using the earth leakage circuit breaker with the inverter circuit, select its rated sensitivity current as follows, independent of the carrier frequency setting:

Rated sensitivity current:

 $I\Delta n \ge 10 \times \{lg1 + lgn + 3 \times (lg2+lgm)\}\$

Ig1, Ig2 : leakage currents of cable path

during commercial power supply

operation

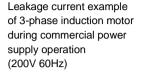
Ign* : leakage current of noise filter on

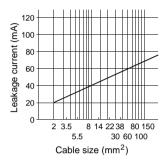
inverter input side

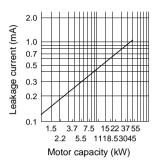
Igm : leakage current of motor during

commercial power supply operation

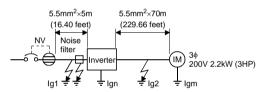
Example of leakage current per 1kW for commercial power supply operation when CV cable is routed in metal conduit (200V 60Hz)







<Example>



- Note 1. The earth leakage circuit breaker should be installed to the primary (power supply) side of the inverter.
 - Ground fault in the secondary side of the inverter can be detected at the running frequency of 120Hz or lower.

Leakage current lg1 (mA)	33 × 5m (16.40 feet) 1000m (3280.80 feet) = 0.17
Leakage current Ign (mA)	0 (without noise filter)
Leakage current Ig2 (mA)	33 × 70m (229.66 feet) 1000m (3280.80 feet) = 2.31
Motor leakage current Igm (mA)	0.18
Total leakage current (mA)	7.64
Reted sensitivity current (≥Ig × 10) (mA)	100

- 3. If the \perp connection neutral point ground fault in the inverter secondary side. The protective ground resistance of the load equipment should be 10Ω or less.
- 4. When the breaker is grounded on the secondary side of the inverter, it may be unnecessarily operated by harmonics if the effective value is less than the rating. In this case, note that the eddy current and hysteresis loss increase and temperature rises.
- * For the leakage current value of the noise filter installed on the inverter input side, contact the corresponding filter manufacturer.

INSTALLATION AND WIRING

2.3.5 Additional guidelines for compliance with UL and CSA standards

(Since we obtained the approval of the UL and CSA standards from the UL, the products conforming to the standards carry the US, Canada UL mark.)



(1) Wiring of the power supply and motor

Use UL Recognized round crimping terminals to wire the input (R, S, T) and output (U, V, W) terminals of the inverter. Crimp the terminals with a crimping tool recommended by the terminal manufacturer. (Refer to page 16)

(2) Fuse

If fuses are used instead of a circuit breaker for input circuit protection, use UL Class RK5 or K5 fuses with ratings as listed below:

Applicable Inverter Type	UL Class	Rating (A)
M4500-001	RK5	6
M4500-003	K5	15
M4500-005	K5	20
M4500-010	K5	40
M4500-025	K5	80
M4500-040	K5	110
M4500-060	K5	200
M4500-100	K5	300

(3) Short-circuit ratings

Suitable for use in a circuit capable of delivering not more than $\underline{}$ A rms symmetrical amperes, 600 volts maximum.

Inverter Type	*
M4500-001 to 060	5,000
M4500-100	10,000

MEMO

CHAPTER 3 OPERATION/CONTROL

This chapter provides the basic "operation" for use of this product.

Always read this chapter before using the equipment.

3.1 Pre-Operation Information	35
3.2 Operation Panel	38
3.3 Operation	44

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

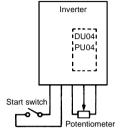
OPERATION/CONTROL

3.1.1 Devices and parts to be prepared for operation

The inverter can be operated in any of the "external operation mode", "PU operation mode", "combined operation mode" and "communication operation mode". Prepare required instruments and parts according to the operation mode.

(1) External operation mode (factory setting)

The inverter is operated under the control of external operation signals (frequency setting potentiometer, start switch, etc.) connected to the terminal block. With input power on, switch on the start signal (STF, STR) to start operation.





Preparation

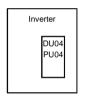
- Start signalSwitch, relay, etc.
- Frequency setting signal0 to 5V, 0 to 10V or 4 to 20mA DC signals from a potentiometer or outside the inverter

Note: Both the start signal and frequency setting signal are required to run the inverter.

(2) PU operation mode

The inverter is operated from the keypad of the PU (FR-DU04/FR-PU04).

This mode does not require the operation signals to be connected and is useful for an immediate start of operation.





Preparation

- Operation unit......Operation panel (FR-DU04), parameter unit (FR-PU04)
- Connection cableTo be prepared for use of the operation unit away from the inverter.

FR-CB2 (option) or the following connector and cable available on the

market:

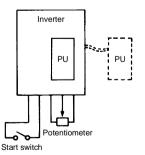
Connector: RJ45 connector

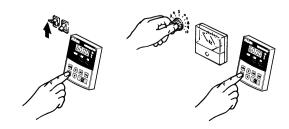
Cable : Cable conforming to EIA568 (e.g. 10BASE-T cable)

(3) External/PU combined operation mode

The inverter is operated with the external operation and PU operation modes combined in any of the following ways:

- The start signal is set with the external signal and the frequency setting signal set from the PU; or
- 2) The start signal is set with the run command key of the PU (FR-DU04/FR-PU04) and the frequency setting signal set with the external frequency setting potentiometer.
- 3) Set "3" in Pr. 79 "operation mode selection".





OPERATION/CONTROL

Preparation

• Start signalSwitch, relay, etc. (for 1)

• Frequency setting signal0 to 5V, 0 to 10V or 4 to 20mA DC signals from a potentiometer or outside

the inverter (for 2)

• Operation unit......Operation panel (FR-DU04), parameter unit (FR-PU04)

• Connection cableTo be prepared for use of the operation unit away from the inverter

FR-CB2 (option) or the following connector and cable available on the

market:

Connector: RJ45 connector

Cable : Cable conforming to EIA568 (e.g. 10BASE-T cable)

4) Combined operation mode

Change the setting of Pr. 79 "operation mode selection" as follows:

Catting	Description		
Setting	Running frequency setting	Start signal	
3	PU (FR-DU04/FR-PU04) • Direct setting and [UP/DOWN] key setting	Terminal signal STF STR	
4	Terminal signal 0 to 5VDC across 2-5 0 to 10VDC across 2-5 4 to 20mADC across 4-5 Multi-speed selection (Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239) Jog frequency (Pr. 15)	Parameter unit • [FWD] key • [REV] key	

(4) Communication operation mode

Communication operation can be performed by connecting a personal computer and the PU connector with the RS-485 communication cable.

Preparation

Connection cableConnector : RJ45 connector

Cable : Cable conforming to EIA568

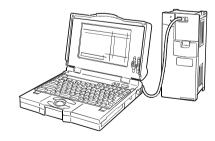
(e.g. 10BASE-T cable)

Personal computer

RS-485, RS-232C converter To be prepared when the

communication port of the personal computer has RS-

232C specifications.



3.1.2 Power on

Before switching power on, check the following:

• Installation check

Make sure that the inverter is installed correctly in a correct place. (Refer to page 7.)

Wiring check

Make sure that the main and control circuits are wired correctly.

Make sure that the options and peripheral devices are selected and connected correctly.

(Refer to page 10.)

• Switch power on.

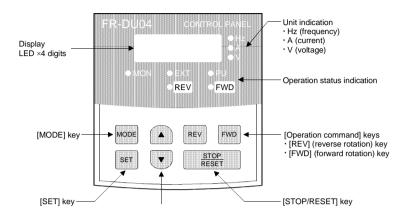
Power-on is complete when the POWER lamp is lit correctly and the operation panel (FR-DU04) displays correct data.

3.2 Operation Panel

OPERATION/CONTROL

With the operation panel (FR-DU04), you can set the running frequency, monitor the operation command display, set parameters, display an error, and copy parameters.

3.2.1 Names and functions of the operation panel (FR-DU04)



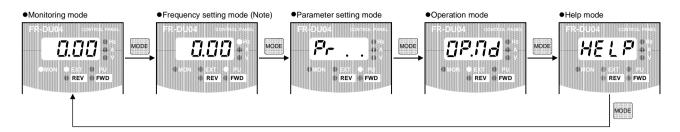
Key indication

Key	Description
[MODE] key	You can select the operation mode or setting mode.
[SET] key	You can determine the frequency and parameter setting.
[UP/DOWN] key (key)	 Used to increase or decrease the running frequency consecutively. Hold down this key to change the frequency. Press this key in the setting mode to change the parameter setting consecutively.
[REV] key	Used to give a reverse rotation command.
[FWD] key	Used to give a forward rotation command.
[STOP/RESET] key	 Used to stop operation. Used to reset the inverter when its output is stopped by the protective function activated (major fault).

• Unit indications, operationg starus indications

Indication	Description
Hz	Lit to indicate the frequency.
Α	Lit to indicate the current.
V	Lit to indicate the voltage.
MON	Lit in the monitor display mode.
PU	Lit in the PU operation mode.
EXT	Lit in the external operation mode.
FWD	Flickers to indicate forward rotation.
REV	Flickers to indicate reverse rotation.

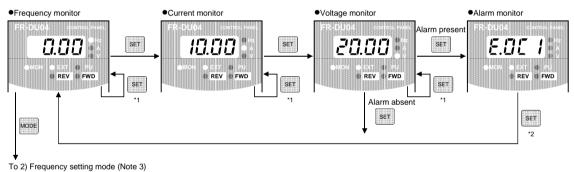
3.2.2 Monitor display changed by pressing the [MODE] key



Note: The frequency setting mode is displayed only in the PU operation mode.

3.2.3 Monitoring mode

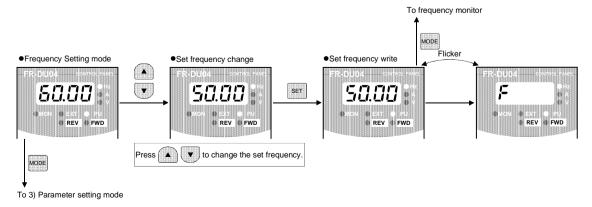
- 1) Monitoring mode
 - Operation command indications in the monitoring mode
 - EXT is lit to indicate external operation.
 - PU is lit to indicate PU operation.
 - Both EXT and PU are lit to indicate PU/external combined operation mode.
 - The monitor display can also be changed during operation.



- Note: 1. Hold down the [SET] key marked *1 for more than 1.5 seconds to change the current monitor to the power-on monitor.
 - 2. Hold down the [SET] key marked *2 for more than 1.5 seconds to display four errors including the most recent one.
 - 3. Shifts to the parameter setting mode when in the external operation mode.

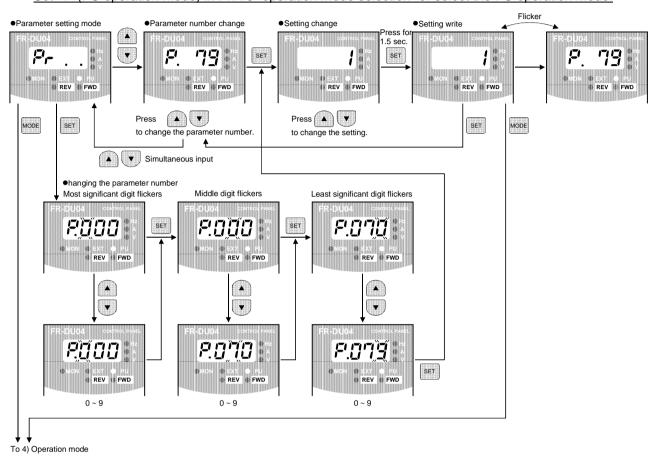
3.2.4 Frequency setting mode

Used to set the running frequency in the PU operation mode.

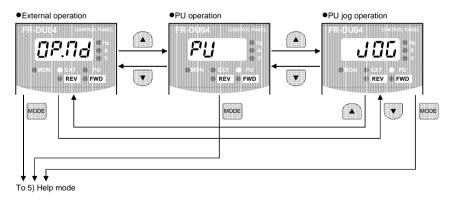


3.2.5 Parameter setting mode

- A parameter value may either be set by updating its parameter number or setting the value digit-by-digit using the [UP/DOWN] key.
- To write the setting, change it and press the [SET] key 1.5 seconds.
 Set "1" (PU operation mode) in Pr. 79 "operation mode selection" or select the PU operation mode.

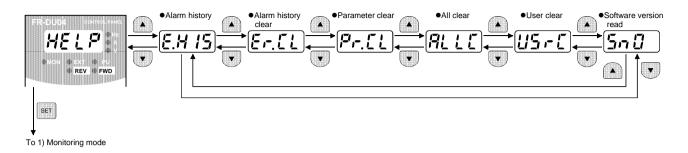


3.2.6 Operation mode



Note: If operation mode changing cannot be made, refer to page 184.

3.2.7 Help mode

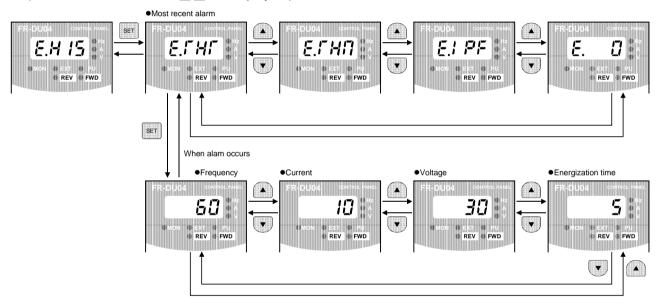


(1) Alarm history

Four past alarms can be displayed with the [UP/DOWN] key.

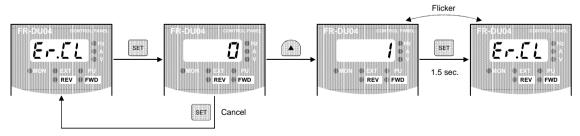
("." is appended to the most recent alarm.)

(When no alarm exists, E.__ _0 is displayed.)



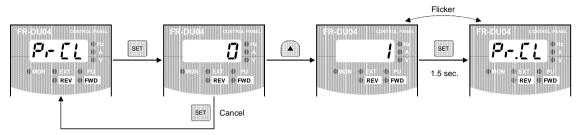
(2) Alarm history clear

Clears all alarm history.



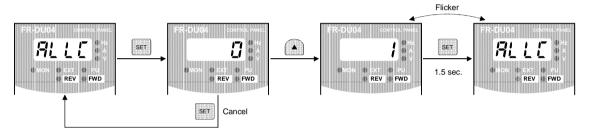
(3) Parameter clear

Initialises the parameter values to the factory settings. The calibration values are not initialized. (Parameter values are not cleared by setting "1" in Pr. 77 "parameter write disable selection).)



(4) All clear

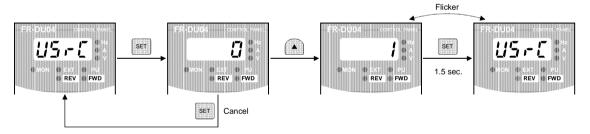
Initialises the parameter values and calibration values to the factory settings.



(5) User clear

Initialises the user-set parameters.

The other parameters are initialized to the factory settings.



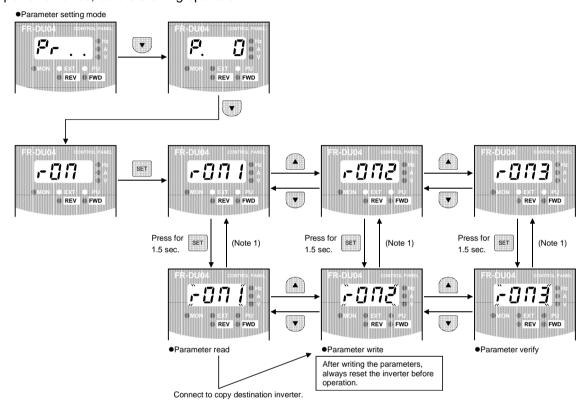
3.2.8 Copy mode

By using the operation panel (FR-DU04), the parameter values can be copied to another inverter (only the M4000 series up to 100).

1) Operation procedure

After reading the parameter values from the copy source inverter, connect the operation panel to the copy destination inverter, and write the parameter values.

After writing the parameters to the inverter of copy destination, always reset the inverter, e.g. switch power off once, before starting operation.



Note: 1. While the copy function is being activated, the monitor display flickers. The display returns to the lit-up state on completion of the copy function.

- 2. If a read error occurs during parameter read, "read error (E.rE1)" is displayed.
- 3. If a write error occurs during parameter write, "write error (E.rE2)" is displayed.
- 4. If a data discrepancy occurs during parameter verify, the corresponding parameter number and "verify error (E.rE3)" are displayed alternately. If the direct frequency setting or jog frequency setting is discrepant, "verify error (E.rE3)" flickers. To ignore this display and continue verify, press the [SET] key.
- 5. When the copy destination inverter is not the M4000 (Up to 100) series, "model error (E.rE4)" is displayed.

Reference: It is recommended to read the parameter values after completion of parameter setting. By writing the parameter values from the operation panel fitted to a new inverter after inverter replacement, parameter setup can be completed.

3.3 Operation

OPERATION/CONTROL

3.3.1 Pre-operation checks

Before starting operation, check the following:

Safety

Perform test operation after making sure that safety is ensured if the machine should become out of control.

Machine

Make sure that the machine is free of damage.

Parameters

Set the parameter values to match the operating machine system environment.

• Test operation

Perform test operation and make sure that the machine operates safely under light load at a low frequency. After that, start operation.

3.3.2 External operation mode (Operation using external input signals)

(1) Operation at 60Hz

Step	Description	Image
1	Power-on → Operation mode check Switch power on and make sure that the operation command indication "EXT" is lit. (If it is not lit, switch to the external operation mode. For operation mode changing, refer to page 40.)	ON ON ORDER
2	Start Turn on the start switch (STF or STR). The operation status indication "FWD" or "REV" flickers. Note: The motor does not start if both the forward and reverse rotation switches are turned on. If both switches are turned on during operation, the motor decelerates to a stop.	Forward rotation Reverse rotation
3	Acceleration → Constant speed Slowly turn the potentiometer (frequency setting potentiometer) full clockwise. The frequency shown on the display increases gradually to 60.00Hz.	54.5 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9 -9
4	Deceleration Slowly turn the potentiometer (frequency setting potentiometer) full counterclockwise. The frequency shown on the display decreases gradually to 0.00Hz. The motor stops running.	0.00 in the same of the same o
5	Stop Turn off the start switch (STF or STR).	Forward rotation Reverse rotation Stop

(2) External jog operation

Keep the start switch (STF or STR) on to perform operation, and switch it off to stop.

- 1) Set Pr. 15 "jog frequency" and Pr. 16 "jog acceleration/deceleration".
- 2) Select the external operation mode.
- 3) Switch on the jog signal. Keep the start switch (STF or STR) on to perform operation. Set the jog signal using any of Pr. 180 to 186 "input terminal function selection".

3.3.3 PU operation mode (Operation using the operation panel (FR-DU04))

(1) Operation at 60Hz

While the motor is running, repeat the following steps 2 and 3 to vary the speed:

Step	Description	Image
1	Power-on → Operation mode check Switch power on and make sure that the operation command indication "PU" is lit. (If it is not lit, switch to the PU operation mode. For operation mode changing, refer to page 40.)	0.00 i
2	Running frequency setting Set the running frequency to 60Hz. First, press the [MODE] key to select the frequency setting mode. Then, press the [UP/DOWN] key to change the setting, and press the [SET] key to write the frequency.	▲ (or) ▼ 50.00 50.00 60.00 60.00 60.00 7.00 8.00 9
3	Start Press the [FWD] or [REV] key. The motor starts running. The monitoring mode is automatically selected and the output frequency is displayed.	FWD (or) REV
4	Stop Press the [STOP] key. The motor is decelerated to a stop.	0.00 = 0.

(2) PU jog operation

Hold down the [FWD] or [REV] key to perform operation, and release it to stop.

- 1) Set Pr. 15 "jog frequency" and Pr. 16 "jog acceleration/deceleration time".
- 2) Select the PU jog operation. (Press the [MODE] key to switch to the operation mode and press the [UP/DOWN] key to choose the PU jog operation.)
- 3) Hold down the [FWD] or [REV] key to perform operation.

 (If the motor remains stopped, check Pr. 13 "starting frequency". The motor will not start if its setting is lower than the starting frequency.)

3.3.4 Combined operation mode (Operation using the external input signals and PU)

When entering the start signal from outside the inverter and setting the running frequency from the PU (Pr. 79 = 3)

The external frequency setting signals and the PU's FWD, REV and STOP keys are not accepted. (Note)

Step	Description	Image
1	Power-on Switch power on.	ON A
2	Operation mode selection Set "3" in Pr. 79 "operation mode selection". The combined operation mode is selected and the operation status indication "EXT" and "PU" are lit.	Flicker
3	Start Turn on the start switch (STF or STR). Note: The motor does not start if both the forward and reverse rotation switches are turned on. If both switches are turned on during operation, the motor decelerates (when Pr. 250 = "9999") to a stop.	Forward rotation Reverse rotation ON 50.00
4	Running frequency setting Using the parameter unit, set the running frequency to 60Hz. The operation command indication "REV" or "FWD" is lit. • Select the frequency setting mode and make step setting. Note: Step setting is the way of changing the frequency consecutively by pressing the [UP/DOWN] key. Hold down the [UP/DOWN] key to change the frequency.	Step setting>
5	Stop Turn off the start switch (STF or STR). The motor stops running.	O.DO S

Note: The stop key is made valid when the Pr.75 "PU stop selection" value is any of 14 to 17.

CHAPTER 4 PARAMETERS

This chapter explains the "parameters" of this product. With the factory settings, the inverter is designed to perform simple variable-speed operation. Set necessary parameter values according to the load and operating specifications. Always read the instructions before using the equipment.

Note: By making parameter settings, you can change the functions of contact input terminals RL, RM, RH, RT, AU, JOG, CS and open collector output terminals RUN, SU, IPF, OL, FU. Therefore, signal names corresponding to the functions are used in the description of this chapter (except in the wiring examples). Note that they are not terminal names.

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

4.1 Parameter List

4.1.1 Parameter list

Func- tion	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To Page:	Customer setting
	0	Torque boost (Note 1)	0 to 30%	0.1%	5%/3%/2%/1% (Note 8)	56	
	1	Maximum frequency	0 to 120Hz	0.01Hz	120Hz	57	
	2	Minimum frequency	0 to 120Hz	0.01Hz	0Hz	57	
S	3	Base frequency	0 to 400Hz	0.01Hz	60Hz	58	
Basic functions	4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz	60Hz	59	
Ĭ,	5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz	30Hz	59	
Sic	6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz	10Hz	59	
Ba	7	Acceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/ 0.01 s	5 s/15 s (Note 5)	60	
	8	Deceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/ 0.01 s	5 s/15 s (Note 5)	60	
	9	Electronic thermal O/L relay	0 to 500A	0.01A	Rated output current	61	
	10	DC injection brake operation frequency	0 to 120Hz, 9999	0.01Hz	3Hz	62	
	11	DC injection brake operation time	0 to 10 s, 8888	0.1 s	0.5 s	62	
	12	DC injection brake voltage	0 to 30%	0.1%	1%	62	
	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	63	
	14	Load pattern selection (Note 1)	0 to 5	1	0	64	
	15	Jog frequency	0 to 400Hz	0.01Hz	5Hz	65	
	16	Jog acceleration/deceleration time	0 to 3600 s/	0.1 s/	0.5 s	65	
	47	MDC in out a planting	0 to 360 s	0.01 s		00	
	17 18	MRS input selection	0,2 120 to 400Hz	0.01Hz	0 120Hz	66 57	
	19	High-speed maximum frequency Base frequency voltage (Note 1)	0 to 1000V, 8888,	0.01H2 0.1V	9999	58	
Standard operation functions	20	Acceleration/deceleration reference frequency	9999 1 to 400Hz	0.01Hz	60Hz	60	
tion fu	21	Acceleration/deceleration time increments	0,1	1	0	60	
era	22	Stall prevention operation level	0 to 200%, 9999	0.1%	150%	67	
ard op	23	Stall prevention operation level at double speed	0 to 200%, 9999	0.1%	9999	67	
gue	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz	9999	59	
St	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz	9999	59	
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz	9999	59	
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz	9999	59	
	28	Multi-speed input compensation	0, 1	1	0	68	
	29	Acceleration/deceleration pattern	0, 1, 2, 3	1	0	69	
	30	Regenerative function selection	0, 1, 2	1	0	70	
	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz	9999	71	
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz	9999	71	
	33	Frequency jump 2A Frequency jump 2B	0 to 400Hz, 9999	0.01Hz	9999	71	
	34 35	Frequency jump 2B Frequency jump 3A	0 to 400Hz, 9999 0 to 400Hz, 9999	0.01Hz 0.01Hz	9999 9999	71 71	
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz	9999	71	
	37	Speed display	0,1 to 9998	1	9999	72	
	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	73	
ons	42	Output frequency detection	0 to 400Hz	0.01Hz	6Hz	73	
Output terminal functions	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz	9999	73	
	44	Second acceleration/deceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/0.01 s	5 s	60	
suo	45	Second deceleration time	0 to 3600 s/ 0 to 360 s, 9999	0.1 s/0.01 s	9999	60	
ncti	46	Second torque boost (Note 1)	0 to 30%, 9999	0.1%	9999	56	
J fu	47	Second V/F (base frequency) (Note 1)	0 to 400Hz, 9999	0.01Hz	9999	58	
Second functions	48	Second stall prevention operation current	0 to 200%	0.1%	150%	74	
	49	Second stall prevention operation frequency	0 to 400Hz, 9999	0.01	0	74	
L	50	50 Second output frequency detection 0 to 400Hz 0.01Hz 30Hz 73					

Func- tion	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To Page:	Customer setting
0	52	DU/PU main display data selection	0 to 20, 22, 23, 24, 25, 100	1	0	76	
Display functions	53	PU level display data selection	0 to 3, 5 to 14, 17, 18	1	1	76	
olay fu	54	FM terminal function selection	1 to 3, 5 to 14, 17, 18, 21	1	1	76	
Disp	55	Frequency monitoring reference	0 to 400Hz	0.01Hz	60Hz	78	
	56	Current monitoring reference	0 to 500A	0.01A	Rated output current	78	
Automatic restart functions	57	Restart coasting time	0, 0.1 to 5 s, 9999	0.1 s	9999	79	
Auto res func	58	Restart cushion time	0 to 60 s	0.1 s	1.0 s	79	
Additional function	59	Remote setting function selection	0, 1, 2	1	0	81	
	60	Intelligent mode selection	0 to 8	1	0	82	
[]	61	Reference I for intelligent mode	0 to 500A, 9999	0.01A	9999	83	
	62	Ref. I for intelligent mode accel.	0 to 200%, 9999	0.1%	9999	84	
	63	Ref. I for intelligent mode decel.	0 to 200%, 9999	0.1%	9999	84	
	64	Starting frequency for elevator mode	0 to 10Hz, 9999	0.01Hz	9999	84	
	65	Retry selection	0 to 5	1	0	85	
ions	66	Stall prevention operation level reduction starting frequency	0 to 400Hz	0.01Hz	60Hz	67	
ınct	67	Number of retries at alarm occurrence	0 to 10,101 to 110	1	0	85	
n fu	68	Retry waiting time	0 to 10 s	0.1 s	1 s	85	
ctio	69	Retry count display erasure	0		0	85	
Operation selection functions	70	Special regenerative brake duty	0 to 15%/0 to 30% (Note 9)	0.1%	0%	70	
tior	71	Applied motor	0 to 8, 13 to 18	1	0	87	
era	72	PWM frequency selection	0 to 15	1	2	88	
ğ	73	0-5V/0-10V selection	0 to 5, 10 to 15	1	1	89	
	74	Filter time constant	0 to 8	1	1	90	
,	75	Reset selection/disconnected PU detection/PU stop selection	0 to 3, 14 to 17	1	14	90	
,	76	Alarm code output selection	0, 1, 2, 3	1	0	92	
	77	Parameter write disable selection	0, 1, 2	1	0	93	
	78	Reverse rotation prevention selection	0, 1,	1	0	94	
	79	Operation mode selection	0 to 8	1	0	95	
Advanced magnetic flux vectorcontrol	80 81	Motor capacity Number of motor poles	0.4 to 55kW, 9999 2, 4, 6, 12, 14,	0.01kW 1	9999	98 98	
orco	82	Motor exciting current (Note 3)	16, 9999 0 to , 9999	1	9999	100	
ectc	83	Rated motor voltage	0 to 1000V	0.1V	575	100	
» ×	84	Rated motor frequency	50 to 120Hz	0.01Hz	60Hz	100	
ı flu	89	Speed control gain	0 to 200.0%	0.1%	100%	98	
etic	90	Motor constant (R1) (Note 3)	0 to, 9999	-	9999	100	
agn	91	Motor constant (R2) (Note 3)	0 to, 9999		9999	100	
Ë	92	Motor constant (L1) (Note 3)	0 to, 9999		9999	100	
)ce(93	Motor constant (L2) (Note 3)	0 to, 9999		9999	100	
Ivar	94	Motor constant (X)	0 to, 9999		9999	100	
Ad	95	Online auto tuning selection	0, 1	1	0	106	
	96	Auto tuning setting/status	0, 1, 101	1	0	100	
//F	100	V/F1 (first frequency) (Note 1)	0 to 400Hz, 9999	0.01Hz	9999	108	
le \	101	V/F1 (first frequency voltage) (Note 1)	0 to 1000V	0.1V	0	108	
eris	102	V/F2 (second frequency) (Note 1)	0 to 400Hz, 9999 0 to 1000V	0.01Hz 0.1V	9999	108 108	
nt fle ract	103 104	V/F2 (second frequency voltage) (Note 1) V/F3 (third frequency) (Note 1)	0 to 400Hz, 9999	0.1V 0.01Hz	9999	108	
ooin har							
5-6		, , , , , ,					
5-point flexible V/F characteristics	105 106	V/F3 (third frequency voltage) (Note 1) V/F4 (fourth frequency) (Note 1)	0 to 1000V 0 to 400Hz, 9999	0.1V 0.01Hz	9999	108 108	_

Func- tion	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To Page:	Customer setting
le V/F	107	V/F4 (fourth frequency voltage) (Note 1)	0 to 1000V		0	108	
5-point flexible V/F characteristics	108	V/F5 (fifth frequency) (Note 1)	0 to 400Hz, 9999	0.01Hz	9999	108	
5-poir cha	109	V/F5 (fifth frequency voltage) (Note 1)	0 to 1000V	0.1V	0	108	
	110	Third acceleration/deceleration time	0 to 3600 s/ 0 to 360 s, 9999	0.1 s/0.01 s	9999	60	
su	111	Third deceleration time	0 to 3600 s /0 to 360 s, 9999	0.1 s/0.01 s	9999	60	
dio	112	Third torque boost (Note 1)	0 to 30.0%, 9999	0.1%	9999	56	
, an	113	Third V/F (base frequency) (Note 1)	0 to 400Hz, 9999	0.01Hz	9999	58	
Third functions	114	Third stall prevention operation current	0 to 200%	0.1%	150%	74	
	115	Third stall prevention operation frequency	0 to 400Hz	0.01Hz	0	74	
	116	Third output frequency detection	0 to 400Hz, 9999	0.01Hz	9999	73	
	117	Station number	0 to 31	1	0	109	
SU	118	Communication speed	48, 96, 192	1	192	109	
Communication functions	119	Stop bit length/data length	0, 1 (data length 8) 10, 11 (data length 7)	1	1	109	
fior	120	Parity check presence/absence	0, 1, 2	1	2	109	
jca	121	Number of communication retries	0 to 10, 9999	1	1	109	
ommur	122	Communication check time interval	0, 0.1 to 999.8 s, 9999	0.1 s	0	109	
Ö	123	Waiting time setting	0 to 150ms, 9999	1ms	9999	109	
	124	CR, LF presence/absence selection	0,1,2	1	1	109	
	128	PID action selection	10, 11, 20, 21		10	119	
	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	119	
PID control	130	PID integral time	0.1 to 3600 s, 9999	0.1 s	1 s	119	
<u> </u>	131	Upper limit	0 to 100%, 9999	0.1%	9999	119	
₾.	132	Lower limit	0 to 100%, 9999	0.1%	9999	119	
	133	PID action set point for PU operation	0 to 100%	0.01%	0%	119	
	134	PID differential time	0.01 to 10.00 s, 9999	0.01 s	9999	119	
supply-	135	Commercial power supply-inverter switch-over sequence output terminal selection	0, 1	1	0	126	
wer ch-c	136	MC switch-over interlock time	0 to 100.0 s	0.1 s	1.0 s	126	
pov	137	Start waiting time	0 to 100.0 s	0.1 s	0.5 s	126	
Commercial power supply- inverter switch-over	138	Commercial power supply-inverter switch-over selection at alarm occurrence	0, 1	1	0	126	
Com	139	Automatic inverter-commercial power supply switch-over frequency	0 to 60.00Hz, 9999 0.01Hz 9999		9999	126	
	140	Backlash acceleration stopping frequency (Note 6)	0 to 400Hz	0.01Hz	1.00Hz	69	
Backlash	141	Backlash acceleration stopping time (Note 6)	0 to 360 s	0.1 s	0.5 s	69	
Bac	142	Backlash deceleration stopping frequency (Note 6)	0 to 400Hz	0.01Hz	1.00Hz	69	
	143	Backlash deceleration stopping time (Note 6)	0 to 360 s	0.1 s	0.5 s	69	
Display	144	Speed setting switch-over	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110	1	4	72	

149 Stall prevention level at 10V input 0 to 200% 0.1% 200% 200% 150 0.00 0	Func- tion	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To Page:	Customer setting		
150 Output current detection level 0 to 200% 0.1% 150% 151 Output current detection period 0 to 10 s 0.1 s 0 0.1 s 152 Zero current detection period 0 to 10 s 0.0.1 s 0 0.5 s 153 Zero current detection period 0 to 10 s 0.0.1 s 0.0 s 0.5 s 153 Zero current detection period 0 to 1 s 0.01 s 0.5 s 0.5 s 154 Voltage reduction selection during 154 Stall prevention operation selection 0 to 10 s 0.0 to 1 s 0.0 s 0.5 s 154 Voltage reduction selection during 155 Stall prevention operation selection 0 to 31, 100,101 1 0 0 156 Stall prevention operation selection 0 to 31, 100,101 1 0 0 157 OL signal walling time 0 to 25 s, 9999 0.1 s 0 0 158 AM terminal function selection 1 to 3, 5 to 14, 1 1 1 1 1 1 1 1 1 1	ional	148	Stall prevention level at 0V input	0 to 200%	0.1%	150%	67			
151 Output current detection period 0 to 10 s 0.1 s 0 152 267	Addit	149	Stall prevention level at 10V input	0 to 200%	0.1%	200%	67			
153 Zero current detection period 0 to 1 s 0.01 s 0.5 s 154 154 Voltage reduction selection during stall prevention operation 155 RT activated condition 0, 10 1 0 156 Stall prevention operation 156 Stall prevention operation 0 to 25 s, 9999 0.1 s 0 157 OL signal waiting time 0 to 25 s, 9999 0.1 s 0 158 AM terminal function selection 1 to 3, 5 to 14, 17, 18, 21 1 1 1 1 1 1 1 1 1		150	Output current detection level	0 to 200%	0.1%	150%	130			
153 Zero current detection period 0 to 1 s 0.01 s 0.5 s 154 154 Voltage reduction selection during stall prevention operation 155 RT activated condition 0, 10 1 0 156 Stall prevention operation 156 Stall prevention operation 0 to 25 s, 9999 0.1 s 0 157 OL signal waiting time 0 to 25 s, 9999 0.1 s 0 158 AM terminal function selection 110 3, 5 to 14, 17, 18, 21 1 1 1 1 1 1 1 1 1	rent	151	Output current detection period	0 to 10 s	0.1 s	0	130			
153 Zero current detection period 0 to 1 s 0.01 s 0.5 s 154 154 Voltage reduction selection during stall prevention operation 155 RT activated condition 0, 10 1 0 156 Stall prevention operation 156 Stall prevention operation 0 to 25 s, 9999 0.1 s 0 157 OL signal waiting time 0 to 25 s, 9999 0.1 s 0 158 AM terminal function selection 110 3, 5 to 14, 17, 18, 21 1 1 1 1 1 1 1 1 1	Cur	152	Zero current detection level	0 to 200.0%	0.1%	5.0%	131			
154 RT activated condition 0, 10 1 0 1 1 0 1 1 1 0 1 1	7	153	Zero current detection period	0 to 1 s	0.01 s	0.5 s	131			
158 AM terminal function selection 17,18,21 1 1 1 1 1 1 1 1 1	Su	154	S S		1	1	67			
158 AM terminal function selection 17,18,21 1 1 1 1 1 1 1 1 1	ctio			·		_	132			
158 AM terminal function selection 17,18,21 1 1 1 1 1 1 1 1 1	fun				1	_	132			
158 AM terminal function selection 17,18,21 1 1 1 1 1 1 1 1 1	qng	157	OL signal waiting time	•	0.1 s	0	134			
162	0)	158	AM terminal function selection		1	1	76			
The large of the	Additional function	160	User group read selection	0, 1, 10, 11	1	0	135			
The last content of the	after ower	162		0, 1	1	0	79			
168	restart ous po ure	163	First cushion time for restart	0 to 20 s	0.1 s	0 s	79			
168	matic antane fail	164	First cushion voltage for restart	0 to 100%	0.1%	0%	79			
170 Watt-hour meter clear 0	Auto insta	165		0 to 200%	0% 0.1% 150% 79		79			
170 Watt-hour meter clear 0	Suc	168								
Second 171	Sul	169	Parameters set by the manufacturer. Do not set.							
173 User group 1 registration 0 to 999 1 0	itial nitor	170	Watt-hour meter clear	0		0	136			
180 RL terminal function selection 0 to 20, 22, 23, 9999 1 1 1 1 1 1 1 1			Actual operation hour meter clear			-	136			
180 RL terminal function selection 0 to 20, 22, 23, 9999 1 1 1 1 1 1 1 1	ions		0 . 0		+		135			
180 RL terminal function selection 0 to 20, 22, 23, 9999 1 1 1 1 1 1 1 1	nct	174	User group 1 deletion	0 to 999, 9999	1	0	135			
180 RL terminal function selection 0 to 20, 22, 23, 9999 1 1 1 1 1 1 1 1	er fu	175	User group 2 registration	0 to 999	1	0	135			
180 RL terminal function selection 9999 1 0	Ns	176	User group 2 deletion	0 to 999, 9999	1	0	135			
181 RM terminal function selection 9999 1		180	RL terminal function selection	9999	1	0	136			
182 RFI terminal function selection 9999 1 2		181	RM terminal function selection	9999	1	1	136			
191 SU terminal function selection 0 to 199, 9999 1 1 192 IPF terminal function selection 0 to 199, 9999 1 2	suc	182	RH terminal function selection	9999	1	2	136			
191 SU terminal function selection 0 to 199, 9999 1 1 192 IPF terminal function selection 0 to 199, 9999 1 2	function	183	RT terminal function selection	9999	1	3	136			
191 SU terminal function selection 0 to 199, 9999 1 1 192 IPF terminal function selection 0 to 199, 9999 1 2	nment	184	AU terminal function selection	9999	1	4	136			
191 SU terminal function selection 0 to 199, 9999 1 1 192 IPF terminal function selection 0 to 199, 9999 1 2	assigı	185	JOG terminal function selection	9999	1	5	136			
191 SU terminal function selection 0 to 199, 9999 1 1 192 IPF terminal function selection 0 to 199, 9999 1 2	minal	186	CS terminal function selection	9999	1	6	136			
192 IPF terminal function selection 0 to 199, 9999 1 2	Ter			•	ł		139			
					ł		139			
400 01 tomotical formation and action 01 400 0000 4				•	ł		139			
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Func- tion	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To Page:	Customer setting
Additi- onal function	199	User's initial value setting	0 to 999, 9999	1	0	141	
	200	Programmed operation minute/ second selection	0, 2: Minute, second 1, 3: Hour, minute	1	0	142	
	201	Program set 1 1 to 10	0-2: Rotation direction 0-400, 9999: Frequency	1 0.1Hz	0 9999	142	
ration			0-99.59: Time	Minute or second	0		
Programmed operation	211	Program set 2 11 to 20	Rotation direction 0-400, 9999: Frequency 0-99.59: Time	1 0.1Hz Minute or second	0 9999 0	142	
Pro	221	Program set 3 21 to 30	0-2: Rotation direction 0-400, 9999: Frequency 0-99.59: Time	1 0.1Hz Minute or second	0 9999 0	142	
1	231	Timer setting	0 to 99.59		0	59	
_	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz	9999	59	
Multi-speed operation	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz	9999	59	
era	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz	9999	59	
do	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz	9999	59	
eq	236	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz	9999	59	
spe	237	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz	9999	59	
- ≟	238	Multi-speed setting (speed 13) Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz	9999	59	
M	239	Multi-speed setting (speed 14) Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz	9999	59	
S	239	Widiti-speed Setting (speed 13)	0 10 400112, 9999	0.01112	3333	33	
Sub functions	240	Soft-PWM setting	0, 1	1	1	88	
	244	Cooling fan operation selection	0, 1	1	0	146	
Stop selection function	250	Stop selection	0 to 100 s, 9999	0.1 s	9999	147	
Additional function	251	Output phase failure protection selection	0,1	1	1	148	
ddit	252	Override bias	0 to 200%	0.1%	50%	148	
₹ ±	253	Override gain	0 to 200%	0.1%	150%	148	
on	261	Power failure stop selection	0, 1	1	0	149	
Power failure stop function	262	Subtracted frequency at deceleration start	0 to 20Hz	0.01Hz	3Hz	149	
top	263	Subtraction starting frequency	0 to 120Hz, 9999	0.01Hz	60Hz	149	
e s	264	Power-failure deceleration time 1	0 to 3600/0 to 360 s	0.1 s/0.01 s	5 s	149	
ır failuı	265	Power-failure deceleration time 2	0 to 3600/0 to 360 s, 9999	0.1 s/0.01 s	9999	149	
	266	Power-failure deceleration time switch-over frequency	0 to 400Hz	0.01Hz	60Hz	149	
Selection	270	Stop-on-contact/load torque high- speed frequency control selection	0, 1, 2, 3	1	0	151	

Func- tion	Parameter Number	Name	Setting Range		Minimum Setting Increments		tory ting	Refer To Page:	Customer setting
۷ ,	271	High-speed setting maximum current	0 to 2	200%	0.1%	50)%	152	
High-speed frequency control	272	Mid-speed setting minimum current	0 to 2	200%	0.1%	10	0%	152	
gh-s	273	Current averaging range	0 to 400	Hz, 9999	0.01Hz	99	99	152	
ΞŒ	274	Current averaging filter constant	1 to	4000	1	1	6	152	
Stop on contact	275	Stop-on-contact exciting current low- speed multiplying factor	0 to 1000	0%, 9999	1%	9999 (Note 4)	156	
Stop	276	Stop-on-contact PWM carrier frequency	0 to 15	5, 9999	1	9999 (Note 4)	156	
	278	Brake opening frequency (Note 2)	0 to	30Hz	0.01Hz	31	Hz	159	
, ₀	279	Brake opening current (Note 2)	0 to 2	200%	0.1%	13	0%	159	
sequence functions	280	Brake opening current detection time (Note 2)	0 to	2 s	0.1 s	0.3	3 s	159	
f	281	Brake operation time at start (Note 2)	0 to 5 s		0.1 s	0.3 s		159	
)ce	282	Brake operation frequency (Note 2)	0 to 30Hz		0.01Hz	6Hz		159	
<u>len</u>	283	Brake operation time at stop (Note 2)	0 to 5 s		0.1 s	0.3	3 s	159	
ke sed	284	Deceleration detection function selection (Note 2)	0, 1		1	0		159	
Brake	285	Overspeed detection frequency	0 to 30Hz, 9999		0.01Hz	9999		159	
	286	Droop gain	0 to	100%	0.1%	0%		163	
	287	Droop filler constant	0.00 to	1.00 s	0.01s	0.3s		163	
	900	FM terminal calibration	_	_				164	
ဟ	901	AM terminal calibration	_	_				164	
nction	902	Frequency setting voltage bias	0 to 10V	0 to 60Hz	0.01Hz	0V	0Hz	166	
Calibration functions	903	Frequency setting voltage gain	0 to 10V	1 to 400Hz	0.01Hz	5V	60Hz	166	
alibra	904	Frequency setting current bias	0 to 20mA	0 to 60Hz	0.01Hz	4mA	0Hz	166	
	905	Frequency setting current gain	0 to 20mA	1 to 400Hz	0.01Hz	20mA	60Hz	166	
Additional function	990	Buzzer control	0, 1		1		1	171	

- Note: 1. Indicates the parameter settings which are ignored when the advanced magnetic flux vector control mode is selected.
 - 2. Can be set when Pr. 80, Pr. 81 \neq 9999, Pr. 60 = 7 or 8.
 - 3. Can be accessed when Pr. 80, Pr. 81 \neq 9999, Pr. 77 = 801.
 - 4. Can be accessed when Pr. 270 = 1 or 3, Pr. 80, Pr. 81 \neq 9999.
 - 5. The setting depends on the inverter capacity. (up to 7.5K/15K or more)
 - 6. Can be accessed when Pr. 29 = 3.
 - 7. The half-tone screened parameters allow their settings to be changed during operation if 0 (factory setting) has been set in Pr. 77. (Note that the Pr. 72 and Pr. 240 settings cannot be changed during external operation.)
 - 8. The setting depends on the inverter capacity: (001)/(003)/(005, 010)/(020 or more)
 - 9. The setting depends on the inverter capacity: (001)/(003 to 005).

4.1.2 List of Parameters Classified by Purposes of Use

Set the parameters according to the operating conditions. The following list indicates purposes of use and parameters. (For full information on the parameters, Refer to Chapter 4.)

,
7, Pr.
,

4.1.3 Parameter recommended to be set by the user

We recommend the following parameters to be set by the user.

Set them according to the operation specifications, load, etc.

Parameter Number	Name	Application
1	Maximum frequency	Lload to get the maximum and minimum output frequencies
2	Minimum frequency	Used to set the maximum and minimum output frequencies.
7	Acceleration time	
8	Deceleration time	
44	Second acceleration/deceleration time	
45	Second deceleration time	Used to set the acceleration and deceleration times.
110	Third acceleration/deceleration time	
111	Third deceleration time	
9	Electronic thermal O/L relay	Used to set the current of the electronic overcurrent protection to protect the motor from overheat.
14	Load pattern selection	Used to select the optimum output characteristics which match the application and load characteristics.
71	Applied motor	Used to set the thermal characteristics of the electronic overcurrent protection according to the motor used.
73	0-5V/0-10V selection	Used to select the specifications of the frequency setting signal entered across terminal 2-5 to perform operation with the voltage input signal.
900	FM terminal calibration	Used to calibrate the meters connected across terminals FM-SD and AM-5.
901	AM terminal calibration	Osed to camprate the meters connected across terminals FW-SD and AW-S.
902	Frequency setting voltage bias	
903	Frequency setting voltage gain	Used to set the magnitude (slope) of the output frequency relative to the
904	Frequency setting current bias	frequency setting signal (0 to 5V, 0 to 10V or 4 to 20mA DC) as desired.
905	Frequency setting current gain	

4.2 Parameter Function Details

PARAMETERS

Pr. 0 "torque boost"

Pr. 46 "second torque boost"

Pr. 112 "third torque boost"

Related parameters

Pr. 3 "base frequency"

Pr. 19 "base frequency voltage"

Pr. 71 "applied motor"

Pr. 80 "motor capacity"

Pr. 81 "number of motor poles"

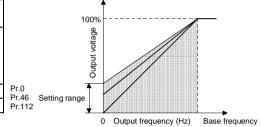
Pr. 180 to Pr. 186

(input terminal function selection)

You can compensate for a voltage drop in the low frequency range to improve motor torque reduction in the low speed range.

- Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque.
- You can select any of the three different starting torque boosts by terminal switching.

	Parameter Factory Number Setting		Setting Range	Remarks
	001	5%		
	003	3%	0 to 200/	
0	005, 010	2%	0 to 30%	
	025 or more	1%		
	46	9999	0 to 30%, 9999	9999: Function invalid
	112	9999	0 to 30%, 9999	9999: Function invalid



<Setting>

- · Assuming that the base frequency voltage is 100%, set the 0Hz voltage in %.
- · A large setting will cause the motor to overheat. The guideline for maximum value is about 10%.
- Pr. 46 is valid when the RT signal is on. Pr. 112 is valid when the X9 signal is on. Use any of Pr. 180 to Pr. 186 to assign the terminal used to input the X9 signal.
- Note: 1. This parameter setting is ignored when Pr. 80 and Pr. 81 have been set to select the advanced magnetic flux vector control mode.
 - 2. Increase the setting when the inverter-to-motor distance is long or motor torque in the low-speed range is insufficient, for example. A too large setting may result in an overcurrent trip.
 - 3. When the RT (X9) signal is on, the other second (third) functions such as second (third) acceleration/deceleration time are also selected.
 - 4. When terminal assignment is changed using Pr. 180 to Pr. 186 during use of the second or third functions, the other functions may be affected. Check the functions of the corresponding terminals before making setting.

4

Pr. 1 "maximum frequency"

Pr. 2 "minimum frequency"

Pr. 18 "high-speed maximum frequency"

Related parameters

Pr.13 "starting frequency"

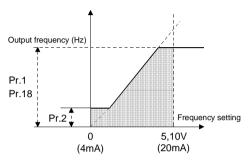
Pr. 903 "frequency setting voltage gain"

Pr. 905 "frequency setting current gain"

Used to clamp the upper and lower limits of the output frequency. Used for high-speed operation at or over 120Hz.

• Can be used to set the upper and lower limits of motor speed.

Parameter Number	Factory Setting	Setting Range
1	120Hz	0 to 120Hz
2	0Hz	0 to 120Hz
10	120∐-7	120 to 400Hz



<Setting>

- Use Pr. 1 to set the upper limit of the output frequency. If the frequency of the frequency command entered is higher than the setting, the output frequency is clamped at the maximum frequency.
 To perform operation over 120Hz, set the upper limit of the output frequency in Pr. 18.
 (When the Pr. 18 value is set, Pr. 1 automatically changes to the frequency in Pr. 18.)
- Use Pr. 2 to set the lower limit of the output frequency.

Note: When the frequency setting analog signal is used to run the motor beyond 60Hz, change the Pr. 903 and Pr. 905 values. If Pr. 1 or Pr. 18 is only changed, the motor cannot run beyond 60Hz.

! CAUTION

!\times When the Pr. 2 setting is higher than the Pr. 13 value, note that the motor will run at the set frequency by merely switching the start signal on, without entering the command frequency.

Pr. 3 "base frequency"

Pr. 19 "base frequency voltage"

Pr. 47 "second V/F (base frequency)

Pr. 113 "third V/F (base frequency)

Related parameters

Pr. 71 "applied motor"

Pr. 80 "motor capacity"

Pr. 81 "number of motor poles"

Pr. 83 "rated motor voltage"

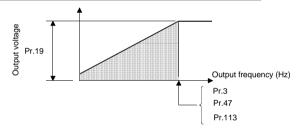
Pr. 84 "rated motor frequency"

Pr. 180 to Pr. 186 (input terminal function selection)

Used to adjust the inverter outputs (voltage, frequency) to the motor rating.

When running a standard motor, generally set the frequency rating to 60Hz. When running the motor using
the commercial power supply-inverter switch-over, set the base frequency to the same value as the power
supply frequency.

Parameter Number	Factory Setting	Setting Range	Remarks
3	60Hz	0 to 400Hz	
19	9999	0 to 1000V, 8888, 9999	8888: 95% of power supply voltage 9999: Same as power supply voltage
47	9999	0 to 400Hz, 9999	9999: Function invalid
113	9999	0 to 400Hz, 9999	9999: Function invalid



<Setting>

- Use Pr. 3, Pr. 47 and Pr. 113 to set the base frequency (rated motor frequency). Three different base frequencies can be set and the required frequency can be selected from among them.
- Pr. 47 is valid when the RT signal is on, and Pr. 113 is valid when the X9 signal is on. Use any of Pr. 180 to Pr. 186 to assign the terminal used to input the X9 signal.
- Use Pr. 19 to set the base voltage (e.g. rated motor voltage).

Note: 1. Set the base frequency to 60Hz when using a constant-torque motor.

- 2. When the advanced magnetic flux vector control mode has been selected using Pr. 80 and Pr. 81, Pr. 3, Pr. 47, Pr. 113 and Pr. 19 are made invalid and Pr. 84 and Pr. 83 are made valid.
- 3. When "2" (5-point flexible V/F characteristics) is set in Pr. 71, the Pr. 47 and Pr. 113 settings are made invalid.
- 4. When the RT (X9) signal is on, the other second (third) functions such as second (third) acceleration/deceleration time are also selected.
- 5. When terminal assignment is changed using Pr. 180 to Pr. 186 during use of the second or third functions, the other functions may be affected. Check the functions of the corresponding terminals before making setting.

Pr. 4 "3-speed setting (high speed)"

Pr. 5 "3-speed setting (middle speed)"

Pr. 6 "3-speed setting (low speed)"

Pr. 24 to Pr. 27 "multi-speed setting (speeds 4 to 7)"

Pr. 232 to Pr. 239 "multi-speed setting (speeds 8 to 15)"

Related parameters

Pr. 1 "maximum frequency"

Pr. 2 "minimum frequency"

Pr. 15 "jog frequency"

Pr. 28 "multi-speed input compensation"

Pr. 29 "acceleration/deceleration pattern"

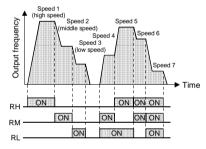
Pr. 79 "operation mode selection"

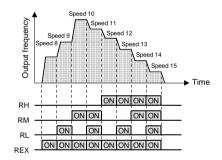
Pr. 180 to Pr. 186 (input terminal function selection)

Used to preset the running speeds in parameters and switch between them using terminals.

- Any speed can be selected by switching on-off the contact signal (RH, RM, RL or REX signal).
- By using these functions with jog frequency (Pr. 15), maximum frequency (Pr. 1) and minimum frequency (Pr. 2), up to 18 speeds can be set.
- Valid in the external operation mode or PU/external combined operation mode (Pr. 79 = 3 or 4).

Parameter Number	Factory Setting	Setting Range	Remarks
4	60Hz	0 to 400Hz	
5	30Hz	0 to 400Hz	
6	10Hz	0 to 400Hz	
24 to 27	9999	0 to 400Hz, 9999	9999: Not selected
232 to 239	9999	0 to 400Hz, 9999	9999: Not selected





<Setting>

- Set the running frequencies in the corresponding parameters.
- Each speed (frequency) can be set as desired between 0 and 400Hz during inverter operation. After the required multi-speed setting parameter has been read, the setting can be changed by pressing the [UP/DOWN] key. (In this case, when you release the [UP/DOWN] key, press the [SET] key to store the set frequency. When using the FR-PU04 (option), press the [WRITE] key.)
- Use any of Pr. 180 to Pr. 186 to assign the terminal used to input the REX signal.
- Note: 1. The multi-speed settings override the main speeds (across terminals 2-5, 4-5).
 - 2. The multi-speeds can also be set in the PU or external operation mode.
 - 3. For 3-speed setting, if two or three speeds are simultaneously selected, priority is given to the frequency setting of the lower signal.
 - 4. Pr. 24 to Pr. 27 and Pr. 232 to Pr. 239 settings have no priority between them.
 - 5. The parameter values can be changed during operation.
 - 6. When terminal assignment is changed using Pr. 180 to Pr. 186, the other functions may be affected. Check the functions of the corresponding terminals before making setting.

Pr. 7 "acceleration time"

Pr. 8 "deceleration time"

<u>Pr. 20 "acceleration/deceleration reference</u> frequency"

Pr. 21 "acceleration/deceleration time increments"

Pr. 44 "second acceleration/deceleration time"

Pr. 45 "second deceleration time"

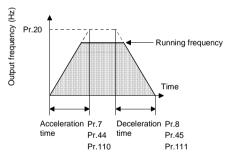
Pr. 110 "third acceleration/deceleration time"

Pr. 111 "third deceleration time"

Used to set motor acceleration/deceleration time.

Set a larger value for a slower speed increase/decrease or a smaller value for a faster speed increase/decrease.

Parameter Number		Factory Setting	Setting Range	Remarks
7	010 or less	5 s	0 to 3600 s/0 to 360 s	
,	025 or more	15 s	0 10 3000 8/0 10 300 8	
8	010 or less	5 s	0 to 3600 a/0 to 360 a	
0	025 or more	15 s	0 to 3600 s/0 to 360 s	
	20	60Hz (50Hz)	1 to 400Hz	
	21	0	0, 1	0: 0 to 3600 s, 1: 0 to 360 s
44	010 or less	E o	0 to 3600 s/0 to 360 s	
44	025 or more	5 s	0 10 3600 \$/0 10 360 \$	
45	010 or less	0000	0 to 3600 a/0 to 360 a 0000	9999: Acceleration time =
45	025 or more	9999	0 to 3600 s/0 to 360 s, 9999	deceleration time
440	010 or less	0000	0 to 2000 o/0 to 200 o 0000	0000. Function invalid
110	025 or more	9999	0 to 3600 s/0 to 360 s, 9999	9999: Function invalid
111	010 or less	0000	0 to 3600 a/0 to 360 a 0000	9999: Acceleration time =
111	025 or more	9999	0 to 3600 s/0 to 360 s, 9999	deceleration time



<Setting>

- Use Pr. 7, Pr. 44 and Pr. 110 to set the acceleration time required to reach the frequency set in Pr. 20 from 0Hz.
- Use Pr. 8, Pr. 45 and Pr. 111 to set the deceleration time required to reach 0Hz from the frequency set in Pr. 20.
- Pr. 44 and Pr. 45 are valid when the RT signal is on, and Pr. 110 and Pr. 111 are valid when the X9 signal is on. When both RT and X9 are on, Pr. 110 and Pr. 111 are valid.
- Use any of Pr. 180 to Pr. 186 to assign the terminal used to input the X9 signal.
- Set "9999" in Pr. 45 and Pr. 111 to make the deceleration time equal to the acceleration time (Pr. 44, Pr. 110).
- When "9999" is set in Pr. 110, the function is made invalid.

Related parameters

Pr. 3 "base frequency"

Pr. 29 "acceleration/deceleration pattern"

Pr. 180 to Pr. 186 (input terminal function selection)

- Note: 1. In S-shaped acceleration/deceleration pattern A (refer to page 69), the set time is a period required to reach the base frequency set in Pr. 3.
 - Acceleration/deceleration time calculation expression when the set frequency is the base frequency or higher

$$t = \frac{4}{9} \times \frac{T}{(Pr.3)^2} \times f^2 + \frac{5}{9} T$$

T: Acceleration/deceleration time setting (seconds)

f: Set frequency (Hz)

 Guideline for acceleration/deceleration time at the base frequency of 60Hz (0Hz to set frequency)

Frequency setting (Hz) Acceleration/ decelerationtime (seconds)	60	120	200	400
5	5	12	27	102
15	15	35	82	305

- 2. If the Pr. 20 setting is changed, the settings of calibration functions Pr. 903 and Pr. 905 (frequency setting signal gains) remain unchanged. To adjust the gains, adjust calibration functions Pr. 903 and Pr. 905.
- 3. When the setting of Pr. 7, Pr. 8, Pr. 44, Pr. 45, Pr. 110 or Pr. 111 is "0", the acceleration/deceleration time is 0.04 seconds. At this time, set 120Hz or less in Pr. 20.
- 4. When the RT (X9) signal is on, the other second (third) functions such as second (third) torque boost are also selected.
- 5. If the shortest acceleration/deceleration time is set, the actual motor acceleration/deceleration time cannot be made shorter than the shortest acceleration/deceleration time determined by the mechanical system's GD² and motor torque.

Pr. 9 "electronic overcurrent protection"

Related parameter

Pr. 71 "applied motor"

Set the current of the electronic overcurrent protection to protect the motor from overheat. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed.

Parameter Number	Factory Setting	Setting Range
9	Rated output current*	0 to 500A

^{*001} are set to 85% of the rated inverter current.

<Setting>

- Set the rated current [A] of the motor.
- Setting of "0" makes the electronic overcurrent protection (motor protective function) invalid. (The inverter's output transistor protective function is valid.)
- When constant-torque motor is used, set "1" or any of "13" to "18" in Pr. 71 to select the 100% continuous torque characteristic in the low speed range. Then, set the rated motor current in Pr. 9.
- Note: 1. When two or more motors are connected to the inverter, they cannot be protected by the electronic overcurrent protection. Install an external thermal relay to each motor.
 - 2. When a difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic overcurrent protection will be deteriorated. In this case, use an external thermal relay.
 - 3. A special motor cannot be protected by the electronic overcurrent protection. Use an external thermal relay.

PARAMETERS

Pr. 10 "DC dynamic brake operation frequency"

Pr. 11 "DC dynamic brake operation time"

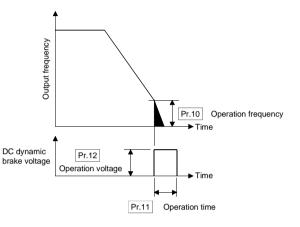
Pr. 12 "DC dynamic brake voltage"

Related parameters -

Pr. 13 "starting frequency"
Pr. 71 "applied motor"

By setting the stopping DC dynamic brake voltage (torque), operation time and operation starting frequency, the stopping accuracy of positioning operation, etc. or the timing of operating the DC dynamic brake to stop the motor is adjusted according to the load.

Parameter Number	Factory Setting	Setting Range	Remarks
10	3Hz	0 to 120Hz, 9999	9999: Operated at or below Pr. 13 value.
11	0.5 s	0 to 10 s, 8888	8888: Operated when X13 signal switches on.
12	1%	0 to 30%	



<Setting>

- Use Pr. 10 to set the frequency at which the DC dynamic brake application is started.
 By setting "9999" in Pr. 10, the motor is decelerated to the frequency set in Pr. 13 and braked.
- Use Pr. 11 to set the period during when the brake is operated. By setting "8888" in Pr. 11, the DC dynamic brake is operated while the X13 signal is on.
- Use any of Pr. 180 to Pr. 186 to assign the terminal used to input the X13 signal.
- Use Pr. 12 to set the percentage of the power supply voltage.

Note: When Pr. 11 = 0 or 8888 or Pr. 12 = 0, DC dynamic brake operation cannot be performed.

! CAUTION

- ⚠ In the orientation (using option) mode, do not set "8888" in Pr. 11. The motor may not be stopped in the correct position.
- Install a mechanical brake. No holding torque is provided.

4

Pr. 13 "starting frequency"

Related parameters

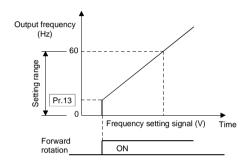
Pr. 2 "minimum frequency"

You can set the starting frequency between 0 and 60Hz.

• Set the starting frequency at which the start signal is switched on.

Parameter Number	Factory Setting	Setting Range
13	0.5Hz	0.01 to 60Hz

<Setting>



Note: The inverter will not start if the frequency setting signal is less than the value set in Pr. 13 "starting frequency".

For example, when 5Hz is set in Pr. 13, the motor will start running when the frequency setting signal reaches 5Hz.

/ CAUTION

!\text{\text{When the Pr. 13 setting is lower than the Pr. 2 value, note that the motor will run at the set frequency by merely switching the start signal on, without entering the command frequency.

Pr. 14 "load pattern selection"

Related parameters

Pr. 0 "torque boost"

Pr. 80 "motor capacity"

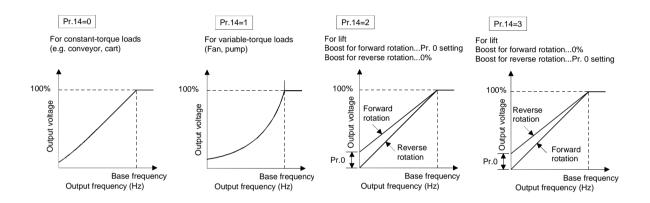
Pr. 81 "number of motor poles"

Pr. 180 to Pr. 186

(input terminal function selection)

You can select the optimum output characteristic (V/F characteristic) for the application and load characteristics.

Parameter Number	Factory Setting	Setting Range
14	0	0 to 5



Setting	Output Characteristics		Application	
0		For constant-tor	que load	Conveyor, cart, etc.
1		For variable-tor	que load	Fan, pump
2	For constant-	Boost for reverse rotation 0%	Boost for forward rotationPr. 0 setting	For lift load
3	torque lift	Boost for forward rotation 0%	Boost for reverse rotationPr. 0 setting	For incload
		ONFor constant-torque load (same as in setting = 0) OFFFor constant-torque lift, boost for reverse rotation 0% (same as in setting = 2)		Load pattern selection
4	RT signal			
	ONFor constant-torque load (same as in setting = 0) OFFFor constant-torque lift, boost for forward rotation 0% (same as in setting = 3)		switching function using RT signal	
5				

- Note: 1. This parameter setting is ignored when Pr. 80 and Pr. 81 have been set to select the advanced magnetic flux vector control mode.
 - 2. When the RT signal is on, the other second functions such as second acceleration/deceleration time and second torque boost are also selected.
 - 3. When the setting is 4 or 5, X17 signal may be used instead of the RT signal. Use any of Pr. 180 to Pr. 186 to assign the terminal used to input the X17 signal.

Pr. 15 "jog frequency"

Pr. 16 "jog acceleration/deceleration time"

Related parameters

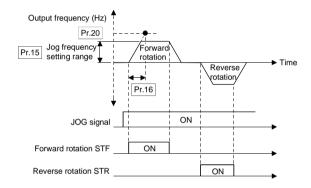
- Pr. 20 "acceleration/deceleration reference frequency"
- Pr. 21 "acceleration/deceleration time increments"
- Pr. 79 "operation mode selection"
- Pr. 180 to Pr. 186

(input terminal function selection)

For jog operation in the external operation mode, choose the jog operation function using input terminal function selection, and turn the JOG signal on. Start and stop can then be made with the start signal (STF, STR). In the PU operation mode, jog operation can also be performed using the PU (FR-DU04/FR-PU04).

• Set the frequency and acceleration/deceleration time for jog operation

Parameter Number	Factory Setting	Setting Range	Remarks
15	5Hz	0 to 400Hz	
16	0.5 s	0 to 3600 s	When Pr. 21 = 0
16	0.5 \$	0 to 360 s	When Pr. 21 = 1



- Note: 1. In S-shaped acceleration/deceleration pattern A, the set time is a period of time required to reach Pr. 3 "base frequency".
 - 2. The acceleration time and deceleration time cannot be set separately for jog operation.
 - 3. The Pr. 15 "jog frequency" setting should be equal to or greater than the Pr. 13 "starting frequency" setting.

Pr. 17 "MRS input selection"

Used to select the logic of the MRS signal.

When the MRS signal switches on, the inverter shuts off the output.

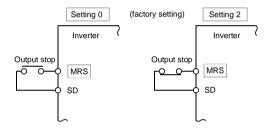
Parameter Number	Factory Setting	Setting Range
17	0	0, 2

<Setting>

Pr. 17 Setting	Specifications of MRS Signal
0	Normally open input
2	Normally closed input (N/C contact input specifications)

<Wiring example>

For sink logic



Pr. 18 → Refer to Pr. 1, Pr. 2.

Pr. 19 → Refer to Pr. 3.

Pr. 20, Pr. 21 → Refer to Pr.15, Pr. 16.

- Pr. 22 "stall prevention operation level"
- Pr. 23 "stall prevention operation level at double speed"
- Pr. 66 "stall prevention operation level reduction starting frequency"
- Pr. 148 "stall prevention operation level at 0V input"
- Pr. 149 "stall prevention operation level at 10V input"

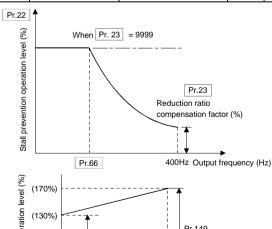
Related parameters

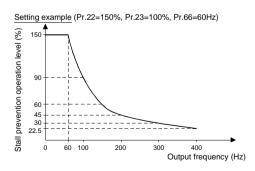
- Pr. 48 "second stall prevention operation current"
- Pr. 49 "second stall prevention operation frequency"
- Pr. 73 "0-5V/0-10V selection"
- Pr. 114 "third stall prevention operation current"
- Pr. 115 "third stall prevention operation frequency"
- Pr. 156 "stall prevention operation selection"

Pr. 154 "voltage reduction selection during stall prevention operation"

- Set the output current level at which the output frequency is adjusted so that the inverter will not come to an alarm stop due to overcurrent etc.
- For high-speed operation at or over 60Hz, acceleration may not be made because the motor current does not increase. To improve the operation characteristics of the motor in such a case, the stall prevention level in the high-frequency range can be reduced. This is effective for operation of a centrifugal separator up to the high-speed range. Normally, set 60Hz in Pr. 66 and 100% in Pr. 23.
- For operation in the high-frequency range, the current in the locked motor state is smaller than the rated output current of the inverter and the inverter does not result in an alarm (protective function is not activated) if the motor is at a stop. To improve this and activate the alarm, the stall prevention level can be reduced.
- In order to provide torque during stall prevention, Pr. 154 is factory-set not to reduce the output voltage. The setting of reducing the output voltage further decreases the probability of overcurrent trip occurrence.
- The stall prevention operation level can be varied by entering the analog signal into terminal 1.

Parameter Number	Factory Setting	Setting Range	Remarks
22	150%	0 to 200%, 9999	9999: Analog variable
23	9999	0 to 200%, 9999	9999: Constant according to Pr. 22
66	60Hz	0 to 400Hz	
148	150%	0 to 200%	(Bias)
149	200%	0 to 200%	(Gain)
154	1	0, 1	O: Output voltage reduced Output voltage not reduced





<Setting>

- In Pr. 22, set the stall prevention operation level. Normally set it to 150% (factory setting). Set "0" in Pr. 22 to disable the stall prevention operation.
- To reduce the stall prevention operation level in the high-frequency range, set the reduction starting frequency in Pr. 66 and the reduction ratio compensation factor in Pr. 23.

Calculation expression for stall prevention operation level

$$\begin{split} &\text{Stall prevention operation level (\%) = A + B \times [\frac{Pr.22-A}{Pr.22-B}] \times [\frac{Pr.23-100}{100}]} \\ &\text{where, A} = \frac{Pr.66 \text{ (Hz)} \times Pr.22 \text{ (\%)}}{\text{output frequency (Hz)}} \text{, B} = \frac{Pr.66 \text{ (Hz)} \times Pr.22 \text{ (\%)}}{400 \text{Hz}} \end{split}$$

- By setting "9999" (factory setting) in Pr. 23, the stall prevention operation level is constant at the Pr. 22 setting up to 400Hz.
- Set "9999" in Pr. 22 to vary the stall prevention operation level using the analog signal (0-5V/0-10V) entered to the frequency setting auxiliary input terminal [1]. (Use Pr. 73 to select between 10V and 5V.)
- Use Pr. 148 and Pr. 149 to adjust the gain and bias of the analog signal.
- Set "0" in Pr. 154 to reduce the output voltage during stall prevention operation.

Note: When Pr. 22 = "9999", terminal 1 is exclusively used for setting the stall prevention operation level. The auxiliary input and override functions are not activated.

! CAUTION

- ① Do not set a too small value as the stall prevention operation current. Otherwise, torque generated will reduce.
- Test operation must be performed. Stall prevention operation during acceleration may increase the acceleration time.

Stall prevention operation during constant speed may change the speed suddenly. Stall prevention operation during deceleration may increase the deceleration time, increasing the deceleration distance.

Pr. 24 to Pr. 27 → Refer to Pr. 4 to Pr. 6.

Related parameters

Pr. 59 "remote setting function" Pr. 73 "0-5V/0-10V selection"

Pr. 28 "multi-speed input compensation"

By entering a compensation signal into the frequency setting auxiliary input terminal 1 (Note 2), the speeds (frequencies) of multi-speed settings or the speed setting made by remote setting function can be compensated for.

Parameter Number	Factory Setting	Setting Range	Remarks
28	0	0, 1	0: Not compensated, 1: Compensated

Note: 1. Use Pr. 73 to select the compensation input voltage between 0 to $\pm 5V$ and 0 to $\pm 10V$.

2. When any of "4, 5, 14 and 15" is set in Pr. 73, the compensation signal is entered into terminal 2. (Override functions)

Pr. 29 "acceleration/deceleration pattern"

Pr. 140 "backlash acceleration stopping frequency"

Pr. 141 "backlash acceleration stopping time"

Pr. 142 "backlash deceleration stopping frequency"

Pr. 143 "backlash deceleration stopping time"

Related parameters

Pr. 3 "base frequency"

Pr. 7 "acceleration time"

Pr. 8 "deceleration time"

Pr. 20 "acceleration/deceleration reference frequency"

Pr. 44 "second acceleration/ deceleration time"

Pr. 45 "second deceleration time"

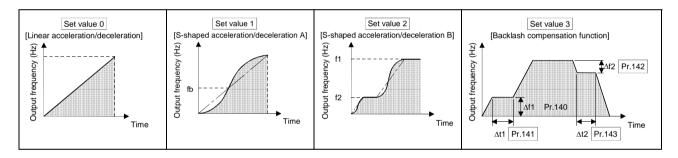
Pr. 110 "third acceleration/ deceleration time"

Pr. 111 "third deceleration time"

Set the acceleration/deceleration pattern.

Also, you can suspend acceleration/deceleration at set frequencies and for the time period set in the parameters.

Parameter Number	Factory Setting	Setting Range	Remarks
29	0	0, 1, 2, 3	3: Backlash compensation
140	1.00Hz	0 to 400Hz	Valid when Pr. 29 = 3.
141	0.5 s	0 to 360 s	Valid when Pr. 29 = 3.
142	1.00Hz	0 to 400Hz	Valid when Pr. 29 = 3.
143	0 s	0 to 360 s	Valid when Pr. 29 = 3.



<Setting>

Pr. 29 Setting	Function	Description	
0	Linear acceleration/ deceleration	Linear acceleration/deceleration is made up/down to the preset frequency (factory setting).	
1	S-shaped acceleration/ deceleration A (Note 1)	For machine tool spindles This setting is used when it is necessary to make acceleration/deceleration in a short time up to the 60Hz or higher speed range. In this acceleration/deceleration pattern, fb (base frequency) is always the inflection point of an S shape, and you can set the acceleration/deceleration time according to the reduction in motor torque in the 60Hz or higher constant-output operation range.	
2	S-shaped acceleration/ deceleration B	Prevention of cargo collapse on conveyor, etc. This setting provides S-shaped acceleration/deceleration from f2 (current frequency) to f1 (target frequency), easing an acceleration/deceleration shock. This pattern has an effect on the prevention of cargo collapse, etc.	
3	Backlash compensation (Note 2, 3)	Backlash compensation for reduction gear, etc. This function stops the speed change temporarily during acceleration/deceleration, reducing a shock generated when a reduction gear backlash is eliminated suddenly. Use Pr. 140 to Pr. 143 to set the stopping times and stopping frequencies in accordance with the above diagrams.	

- Note: 1. For the acceleration/deceleration time, set the time required to reach the "base frequency" in Pr. 3, not the "acceleration/deceleration reference frequency" in Pr. 20. For details, refer to Pr. 7 and Pr. 8.
 - 2. Pr. 140 to Pr. 143 is accessible when "3" is set in Pr. 29.
 - 3. The acceleration/deceleration time is increased by the stopping time.

PARAMETERS

Pr. 30 "regenerative function selection"

Pr. 70 "special regenerative brake duty"

Related parameters -

Pr. 180 "RL terminal function selection"

Pr. 181 "RM terminal function selection"

Pr. 182 "RH terminal function selection"

Pr. 183 "RT terminal function selection"

Pr. 184 "AU terminal function selection"

Pr. 185 "JOG terminal function selection"

Pr. 186 "CS terminal function selection"

 When making frequent starts/stops with a 010 or less inverter, use the external "high-duty brake resistor" to increase the regenerative brake duty.

Parameter Number	Factory Setting	Setting Range	Remarks
30	0	0 to 2	
		0 to 15%	001
70	0%	0 to 30%	003 to 010
		0%	025 or more

<Setting>

(1) When using the built-in brake resistor, brake unit

• Set "0" in Pr. 30.

The Pr. 70 setting is made invalid.

At this time, the regenerative brake duty is as follows:

M4500-001 to 101......2%

(2) When using the external high-duty brake resistor

- Set "1" in Pr. 30.
- Set "10%" in Pr. 70.

Note: 1. The Pr. 70 setting is invalid for the inverter of 025 or more.

- 2. Pr. 70 "regenerative brake duty" indicates the %ED of the built-in brake transistor operation. Its setting should not be higher than the setting of the brake resistor used. Otherwise, the brake resistor can overheat.
- 3. 7.5K does not have the built-in brake resistor.



<u>^</u>

The Pr. 70 setting must not exceed the setting of the brake resistor used. Otherwise, the brake resistor can overheat.

Pr. 31 "frequency jump 1A"

Pr. 32 "frequency jump 1B"

Pr. 33 "frequency jump 2A"

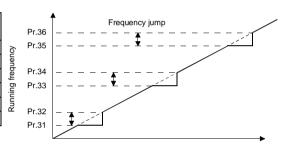
Pr. 34 "frequency jump 2B"

Pr. 35 "frequency jump 3A"

Pr. 36 "frequency jump 3B"

- When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these
 parameters allow resonant frequencies to be jumped. Up to three areas may be set, with the jump
 frequencies set to either the top or bottom point of each area.
- The value set to 1A, 2A or 3A is a jump point and operation is performed at this frequency.

Parameter Number	Factory Setting	Setting Range	Remarks
31	9999	0 to 400Hz, 9999	9999: Function invalid
32	9999	0 to 400Hz, 9999	9999: Function invalid
33	9999	0 to 400Hz, 9999	9999: Function invalid
34	9999	0 to 400Hz, 9999	9999: Function invalid
35	9999	0 to 400Hz, 9999	9999: Function invalid
36	9999	0 to 400Hz, 9999	9999: Function invalid



<Setting>

• To fix the frequency at 30Hz between Pr. 33 and Pr. 34 (30Hz and 35Hz), set 35Hz in Pr. 34 and 30Hz in Pr. 33.

• To jump to 35Hz between 30 and 35Hz, set 35Hz in Pr. 33 and 30Hz in Pr. 34.

Pr.33:35Hz ----

Note: During acceleration/deceleration, the running frequency within the set area is valid.

Pr. 37 "speed display"

Pr. 144 "speed setting switch-over"

Related parameters -

Pr. 52 "PU main display data selection"

Pr. 53 "PU level display data selection"

Pr. 80 "motor capacity"

Pr. 81 "number of motor poles"

The units of the running speed monitor display of the PU (FR-DU04/FR-PU04), the running speed setting in the PU operation mode, and the parameter setting used for frequency setting can be changed from the frequency to the motor speed or machine speed.

Parameter Number	Factory Setting	Setting Range	Remarks
37	0	0, 1 to 9998	0: Frequency setting added
144	4	0, 2, 4, 6, 8, 10, 102, 104, 106, 108, 110	

<Setting>

- To display the machine speed, set in Pr. 37 the machine speed for 60Hz operation.
- To display the motor speed, set the number of motor poles (2, 4, 6, 8, 10) or the number of motor poles plus 100 (102, 104, 106, 108, 110) in Pr. 144.
- When values have been set in both Pr. 37 and Pr. 144, priority is as follows: Pr. 144 = 102 to 110 > Pr. 37 = 1 to 9998 > Pr. 144 = 2 to 10
 - Hence, the half-tone screened settings in the following list become valid.
- When the running speed monitoring has been selected, the parameter setting unit and the running speed setting unit in the PU operation mode depend on the combination of the Pr. 37 and Pr. 144 settings as indicated below:

Running Speed Monitor Display	Parameter Setting Unit Running Speed Setting Unit	Pr. 37 Setting	Pr. 144 Setting
Speed of 4-pole motor (r/min)		0	0
	Hz	0	2 to 10
Motor speed (r/min)		1 to 9998	102 to 110
	r/min	0	102 to 110
Machine speed	Hz	1 to 9998	0
wachine speed	r/min	1 to 9998	2 to 10

- Note: 1. In the V/F control mode, the motor speed is converted from the output frequency and does not match the actual speed. When the advanced magnetic flux vector control mode has been selected in Pr. 80 and 81, this display shows the calculated speed (estimated value found by motor slippage calculation).
 - 2. During PLG feedback control, the data displayed is the same as in advanced magnetic flux vector control. Note that the speed displayed is the actual speed from the PLG.
 - 3. When the running speed display has been selected with "0" set in Pr. 37 and "0" in Pr. 144, the monitor display shows the speed reference for a 4-pole motor (1800r/min is displayed at 60Hz).
 - 4. To change the PU main monitor (PU main display) or PU level meter (PU level display), refer to Pr. 52 and Pr. 53.
 - 5. As the operation panel display is 4 digits, "----" is displayed when the monitored value exceeds "9999".

! CAUTION

Make sure that the running speed and number of poles set are correct. Otherwise, the motor might run at extremely high speed, damaging the machine.

Pr. 41 "up-to-frequency sensitivity"

Related parameters

Pr. 190 "RUN terminal function selection"

Pr. 191 "SU terminal function selection"

Pr. 192 "IPF terminal function selection"

Pr. 193 "OL terminal function selection"

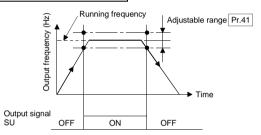
Pr. 194 "FU terminal function selection"

Pr. 195 "ABC terminal function selection"

The ON range of the up-to-frequency signal (SU) output when the output frequency reaches the running frequency can be adjusted between 0 and $\pm 100\%$ of the running frequency.

This parameter can be used to ensure that the running frequency has been reached or used as the operation start signal etc. for related equipment.

Parameter Number	Factory Setting	Setting Range
41	10%	0 to 100%



Pr. 42 "output frequency detection"

Pr. 43 "output frequency detection for reverse rotation"

Pr. 50 "second output frequency detection"

Pr. 116 "third output frequency detection"

The output frequency signal (FU, FU2, FU3) is output when the output frequency reaches or exceeds the setting. This function can be used for electromagnetic brake operation, open signal, etc.

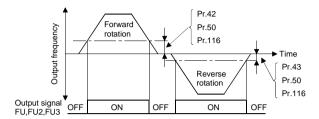
You can also set the detection of the frequency used exclusively for reverse rotation. This function is
effective for switching the timing of electromagnetic brake operation between forward rotation (rise) and
reverse rotation (fall) during vertical lift operation, etc.

Parameter Number	Factory Setting	Setting Range	Remarks
42	6Hz	0 to 400Hz	
43	9999	0 to 400Hz, 9999	9999: Same as Pr. 42 setting
50	30Hz	0 to 400Hz	
116	9999	0 to 400Hz. 9999	9999: Function invalid

<Setting>

Refer to the figure below and set the corresponding parameters:

• When Pr. 43 ≠ 9999, the Pr. 42 setting applies to forward rotation and the Pr. 43 setting applies to reverse rotation.



Output Signal

Parameter Number	Output Signal
42	FU
43	FU
50	FU2
116	FU3

Use Pr. 190 to Pr. 195 to assign the terminals used to output the FU2 and FU3 signals.

- Note: 1. When the inboard option unit is used to exercise PLG feedback control, use the RUN (running) signal. (If the FU, FU2 or FU3 signal is used, the brake may not be opened.)
 - 2. When terminal assignment is changed using Pr. 190 to Pr. 195, the other functions may be affected. Check the functions of the corresponding terminals before making setting.

Pr. 44, Pr. 45 → Refer to Pr. 7.

Pr. 46 → Refer to Pr. 0.

Pr. 47 → Refer to Pr. 3.

Pr. 48 "second stall prevention operation current"

Pr. 49 "second stall prevention operation frequency"

Pr. 114 "third stall prevention operation current"

Pr. 115 "third stall prevention operation frequency"

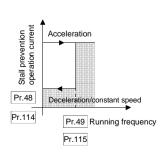
Related parameters

- Pr. 22 "stall prevention operation level"
- Pr. 23 "stall prevention operation level at double speed"
- Pr. 66 "stall prevention operation level reduction starting frequency"
- Pr. 154 "voltage reduction selection during stall prevention operation"
- Pr. 180 to Pr. 186

(input terminal function selection)

- The stall prevention operation level can be changed within the range from 0Hz to the frequency set in Pr. 49 or Pr. 115.
- The stall prevention operation level can be changed by switching the external input signal on-off.

Parameter Number	Factory Setting	Setting Range
48	150%	0 to 200%
49	0	0 to 400Hz, 9999
114	150%	0 to 200%
115	0	0 to 400Hz



<Setting>

- Set the stall prevention operation level in Pr. 48 and Pr. 114.
- Refer to the following list to set values in Pr. 49 and Pr. 115.
- Pr. 114 and Pr. 115 are made valid by switching on the X9 signal. Set "9" in any of Pr. 180 to Pr. 186 to allocate the terminal used to input the X9 signal.

Pr. 49 Setting	Pr. 49 Setting Pr. 115 Setting Operation				
0		Second (third) stall prevention function is not activated.			
0.01Hz to 400Hz		Second (third) stall prevention function is activated according to the			
0.016	12 10 40002	frequency as shown above.			
		Second stall prevention function is activated according to the RT signal.			
9999	Cannot be set.	RT signal ONStall level Pr. 48			
		RT signal OFFStall level Pr. 22			

- Note: 1. When Pr. 49 = "9999", setting "0" in Pr. 48 disables the stall prevention function when the RT signal switches on. When Pr. $49 \neq "9999"$ and Pr. 48 = "0", the stall prevention operation level is 0% when the frequency is equal to or less than the value set in Pr. 49.
 - 2. When the stall prevention operation level signal input function is selected (Pr. 22 = 9999), setting "9999" in Pr. 49 changes the stall prevention operation level from the value of the stall prevention operation level signal (terminal 1 input) to the value set in Pr. 48 when the RT signal switches on.
 - 3. When both the RT and X9 signals are on, the third stall prevention function is selected.
 - 4. When the RT (X9) signal is on, the second (third) functions such as second (third) acceleration/deceleration time are also selected.
 - 5. When terminal assignment is changed using Pr. 180 to Pr. 186, the other functions may be affected. Check the functions of the corresponding terminals before making setting.

! CAUTION

① Do not set a too small value to the second (third) stall prevention operation current. Otherwise, torque generated will decrease.

Pr. 50 → Refer to Pr. 42.

Pr. 52 "DU/PU main display screen data selection"

Pr. 53 "PU level display data selection"

Pr. 54 "FM terminal function selection"

Pr. 158 "AM terminal function selection"

Related parameters

Pr. 37 "speed display"

Pr. 55 "frequency monitoring reference"

Pr. 56 "current monitoring reference"

Pr. 170 "watt-hour meter clear"

Pr. 171 "actual operation hour meter clear"

Pr. 900 "FM terminal calibration"

Pr. 901 "AM terminal calibration"

- You can select the signals shown on the operation panel (FR-DU04)/parameter unit (FR-PU04) main display screen and on the parameter unit (FR-PU04) level meter and signals output to the FM and AM terminals.
- There are two different signal outputs: FM pulse train output terminal and AM analog output terminal. Select the signals using Pr. 54 and Pr. 158.

Parameter Number	Factory Setting	Setting Range
52	0	0 to 20, 22 to 25, 100
53	1	0 to 3, 5 to 14, 17, 18
54	1	1 to 3, 5 to 14, 17, 18, 21
158	1	1 to 3, 5 to 14, 17, 18, 21

<Setting>

Set Pr. 52 to Pr. 54 and Pr. 158 in accordance with the following table:

		Parameter Setting					
	Diamlay	Pr	.52	Pr.53	Pr.54	Pr.158	Full-Scale Value of
Signal Type	Display Unit	DU LED	PU main monitor	PU level meter	FM terminal	AM terminal	FM, AM, Level Meter
No display		×	×	0	×	×	
Output frequency	Hz	0/100	0/100	1	1	1	Pr. 55
Output current	Α	0/100	0/100	2	2	2	Pr. 56
Output voltage	V	0/100	0/100	3	3	3	1000V
Alarm display		0/100	0/100	×	×	×	
Frequency setting	Hz	5	*	5	5	5	Pr. 55
Running speed	r/min	6	*	6	6	6	Pr. 55 value converted into Pr. 37 value
Motor torque	%	7	*	7	7	7	Rated torque of applied motor × 2
Converter output voltage	V	8	*	8	8	8	1000V
Regenerative brake duty	%	9	*	9	9	9	Pr. 70
Electronic overcurrent protection load factor	%	10	*	10	10	10	Protection operation level
Output current peak value	Α	11	*	11	11	11	Pr. 56
Converter output voltage peak value	V	12	*	12	12	12	1000V
Input power	kW	13	*	13	13	13	Rated power of inverter rating × 2
Output power	kW	14	*	14	14	14	Rated power of inverter rating × 2
Input terminal status		×	*	×	×	×	
Output terminal status		×	*	×	×	×	
Load meter **	%	17	17	17	17	17	Pr. 56
Motor exciting current	Α	18	18	18	18	18	Pr. 56
Position pulse		19	19	×	×	×	
Cumulative operation time	hr	20	20	×	×	×	
Reference voltage output		×	×	×	21	21	1440Hz is output to FM terminal. Full-scale voltage is output to AM terminal.
Orientation status		22	22	×	×	×	
Actual operation time	hr	23	23	×	×	×	
Motor load factor	%	24	24	×	X	×	Rated inverter current × 2
Cumulative power	kW	25	25	×	×	×	

When 100 is set in Pr. 52, the monitored values during stop and during operation differ as indicated below: (The LED on the left of Hz flickers during a stop and is lit during running.)

	Pr. 52			
	0	100		
	During operation/during stop	During stop	During operation	
Output frequency	Output frequency	Set frequency	Output frequency	
Output current		Output current		
Output voltage		Output voltage		
Alarm display		Alarm display		

Note: 1. During an error, the output frequency at error occurrence is displayed.

2. During MRS, the values are the same as during a stop. During offline auto tuning, the tuning status monitor has priority.

Note: 1. The monitoring of items marked \times cannot be selected.

- 2. By setting "0" in Pr. 52, the monitoring of "output frequency to alarm display" can be selected in sequence by the SHIFT key.
- 3. *"Frequency setting to output terminal status" on the PU main monitor are selected by "other monitor selection" of the parameter unit (FR-PU04).
- 4. **The load meter is displayed in %, with the current set in Pr. 56 regarded as 100%.
- 5. The motor torque display is valid only in the advanced magnetic flux vector control mode.
- 6. The actual operation time displayed by setting "23" in Pr. 52 is calculated using the inverter operation time. (Inverter stop time is not included.) Set "0" in Pr. 171 to clear it.
- 7. When Pr. 53 = "0", the level meter display of the parameter unit can be erased.
- 8. By setting "1, 2, 5, 6, 11, 17 or 18" in Pr. 53, the full-scale value can be set in Pr. 55 or Pr. 56.
- 9. The cumulative operation time and actual operation time are calculated from 0 to 65535 hours, then cleared, and recalculated from 0.
 - When the operation panel (FR-DU04) is used, the display shows "----" after 9999 or more hours have elapsed.
 - Whether 9999 or more hours have elapsed or not can be confirmed on the parameter unit (FR-PU04).
- 10. The actual operation time is not calculated unless the inverter has operated for longer than one hour continuously.
- 11. When the operation panel (FR-DU04) is used, the display unit is Hz, V or A only.
- 12. The orientation status functions when the FR-A5AP option is used. If the option is not used, "22" may be set in Pr. 52 and the value displayed remains "0" and the function is invalid.

Pr. 55 "frequency monitoring reference"

Pr. 56 "current monitoring reference"

Related parameters

Pr. 37 "speed display"

Pr. 53 "PU level display data selection"

Pr. 54 "FM terminal function selection"

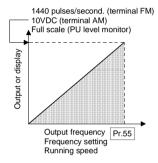
Pr. 158 "AM terminal function selection"

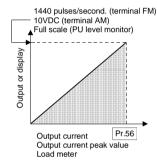
Pr. 900 "FM terminal calibration"

Pr. 901 "AM terminal calibration"

Set the frequency or current which is referenced for display when the frequency or current is selected for the FM and AM terminals and PU level meter display.

Parameter Number	Factory Setting	Setting Range
55	60Hz	0 to 400Hz
56	Rated output current	0 to 500A





<Setting>

Referring to the above figures and following table, set Pr. 55 and Pr. 56:

Monitoring Reference Setting Parameter	Monitored Data Selection	PU Level Display Selection Pr. 53 Setting	FM Terminal Function Selection Pr. 54 Setting	AM Terminal Function Selection Pr. 158 Setting
Fraguanay manitaring	Output frequency (Hz))	1	1	1
Frequency monitoring reference Pr. 55	Frequency setting (Hz)	5	5	5
Telefence F1. 55	Running speed (Pr. 37)	6	6	6
	Output current (A)	2	2	2
Current monitoring	Output current peak value (A)	11	11	11
reference Pr. 56	Load meter (%)	17	17	17
	Motor exciting current (A)	18	18	18
Setting using Pr. 55, Pr.	56	Set to make the PU level meter indication to be in full-scale.	Set to make the terminal FM pulse train output to be 1440 pulses/second.	Set to make the terminal AM output voltage to be 10V.

Note: 1. The maximum pulse train output of terminal FM is 2400 pulses/second. If Pr. 55 is not adjusted, the output of terminal FM will be filled to capacity. Therefore, adjust Pr. 55.

2. The maximum output voltage of terminal AM is 10VDC.

Pr. 57 "coasting time for automatic restart after instantaneous power failure/commercial power supply-inverter switch-over"

Pr. 58 "cushion time for automatic restart after instantaneous power failure/commercial power supply-inverter switch-over"

Pr.162 "Automatic restart after instantaneous power failure selection"

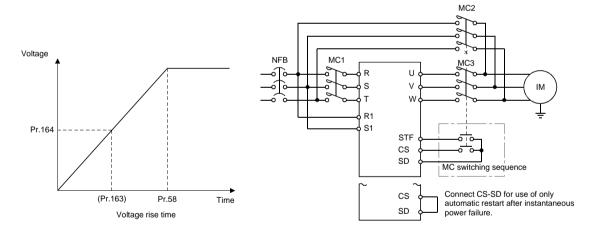
Pr.163 "First cushion time for restart"

Pr.164 "First cushion voltage for restart"

Pr.165 "Restart stall prevention operation level"

You can restart the inverter without stopping the motor (with the motor coasting) when the commercial
power supply is switched to the inverter operation or when the power is restored after an instantaneous
power failure. (When automatic restart operation is set to be enabled, UVT and IPF among the alarm
output signals will not be output at occurrence of an instantaneous power failure.)

Parameter Number	Factory Setting	Setting Range	Remarks
57	9999	0, 0.1 to 5 s, 9999	9999: No restart
58	1.0 s	0 to 60 s	
162	0	0, 1	0: Frequency search 1: No frequency search
163	0 s	0 to 20 s	
164	0%	0 to 100%	
165	150%	0 to 200%	



<Setting>

Refer to the above figures and following table, and set the parameters:

Parameter Number		Setting	Description		
	0		Frequency search made Frequency search is made after detection of an instantaneous power failure.		
162		1	No frequency search Independently of the motor coasting speed, the output voltage is gradually increased with the frequency kept as preset.		
		001	0.5 s coasting time		
	57	003 to 010	1.0 s coasting time	Generally use this setting.	
57		025 or more	3.0 s coasting time		
		0.1 to 5 s	0	fter power is restored from an instantaneous s and 5 s according to the inertia moment	
	9999		No restart		
58		0 to 60 s			
163	0 to 20 s		Normally the motor may be run with the fa	actory settings. These values are adjustable	
164		0 to 100%	to the load (inertia moment, torque).	,	
165		0 to 200%			

Note: 1. When restart operation is selected, UVT and IPF among the alarm output signals are not output at occurrence of an instantaneous power failure.

- 2. If the inverter capacity is more than one rank higher than the motor capacity, an overcurrent (OCT) alarm may take place, disabling the motor from starting.
- 3. When Pr. $57 \neq 9999$, the inverter will not run if the CS signal remain off.
- 4. When Pr. 162 = "0", connection of two or more motors to one inverter will make the inverter function improperly. (The inverter will not start properly.)
- 5. When Pr. 162 = "0", the DC dynamic brake is operated instantly on detection of restarting speed. Therefore, if the inertia moment (GD²) of the load is small, the speed may reduce.
- 6. When Pr. 162 = "1", the output frequency before an instantaneous power failure is stored and output at the time of restart. If the power of the inverter control circuit is lost, the frequency before an instantaneous power failure cannot be stored and the inverter will start at 0Hz.
- 7. The SU and FU signals are not output during restart but are output after the restart cushion time has elapsed.

!CAUTION

♠ Provide mechanical interlocks for MC1 and MC2.

The inverter will be damaged if power is entered into the inverter output section.

• When automatic restart after instantaneous power failure has been selected, the motor and machine will start suddenly (after the reset time has elapsed) after occurrence of an instantaneous power failure. Stay away from the motor and machine. When you have selected automatic restart after instantaneous power failure, apply the supplied CAUTION seals in easily visible places.

Pr. 59 "remote setting function selection"

Related parameters

Pr. 1 "maximum frequency"

Pr. 7 "acceleration time"

Pr. 8 "deceleration time"

Pr. 18 "high-speed maximum frequency"

Pr. 28 "multi-speed input compensation"

Pr. 44 "second acceleration/deceleration time"

Pr. 45 "second deceleration time"

If the operator panel is located away from the control box, you can use contact signals to perform continuous variable-speed operation, without using analog signals.

• When the remote function is used, the output frequency of the inverter can be compensated for as follows:

External operation mode Frequency set by RH/RM operation plus external running frequency other

than multi-speeds

(Set "1" in Pr. 28 to select the compensation input (terminal 1).)

PU operation mode

Darameter

Frequency set by RH/RM operation plus PU running frequency

Number	Setting	Setting Range			
59	0	0, 1, 2			
	Decel	leration (RH) creation (RM) Clear (RL) obtation (STF)	ON	ON	→ Time

<Setting>

Refer to the following table and set the parameter:

Factory

	Operation			
Pr. 59 Setting	Remote setting function	Frequency setting storage function		
0	No			
1	Yes	Yes		
2	Yes	No		

- Use Pr. 59 to select whether the remote setting function is used or not and whether the frequency setting storage function in the remote setting mode is used or not. When "remote setting function yes" is selected, the functions of signals RH, RM and RL are changed to acceleration (RH), deceleration (RM) and clear (RL). Use Pr. 180 to Pr. 186 (input terminal function selection) to set signals RH, RM and RL.
- Note: 1. The frequency can be varied by RH (acceleration) and RM (deceleration) between 0 and the maximum frequency (Pr. 1 or Pr. 18 setting).
 - 2. When the acceleration or deceleration signal switches on, the set frequency varies according to the slope set in Pr. 44 or Pr. 45. The output frequency acceleration/deceleration times are as set in Pr. 7 and Pr. 8, respectively. Therefore, the longer preset times are used to vary the actual output frequency.
 - 3. If the start signal (STF or STR) is off, turning on the acceleration (RH) or deceleration (RM) signal varies the set frequency.
 - 4. The frequency setting storage function stores in memory the remotely-set frequency (frequency set by RH/RM operation) when the acceleration and deceleration signals remain off for more than 1 minute or as soon as the start signal (STF or STR) switches off. When power is switched off, then on, operation is resumed with that value.



! When selecting this function, re-set the maximum frequency according to the machine.

Pr. 60 "intelligent mode selection"

Related parameters

Pr. 0 "torque boost"

Pr. 7 "acceleration time"

Pr. 8 "deceleration time"

Pr. 13 "starting frequency"

Pr. 19 "base frequency voltage"

Pr. 80, Pr. 81

(advanced magnetic flux vector control)

Pr. 278 to Pr. 285

(brake sequence functions)

The inverter automatically sets appropriate parameters for operation.

- If you do not set the acceleration and deceleration times and V/F pattern, you can run the inverter as if appropriate values had been set in the corresponding parameters. This operation mode is useful to start operation immediately without making fine parameter settings.
- Even in the intelligent operation mode, inputting the JOG signal or RT (second function selection) signal during an inverter stop will result in ordinary operation, giving priority to the jog operation or second function selection.

After the inverter has been started in the intelligent operation mode, neither the JOG signal nor the RT signal is accepted.

Parameter Number	Factory Setting	Setting Range
60	0	0 to 8

<Setting>

Pr. 60 Setting	Operation Mode	Description	Automatically Set Parameters
0	Ordinary operation mode		
1, 2	Shortest acceleration/ deceleration mode	Set to accelerate/decelerate the motor in the shortest time. The inverter makes acceleration/deceleration in the shortest time using its full capabilities. During deceleration, an insufficient brake capability may cause the regenerative overvoltage alarm (E.OV3). "1": Stall prevention operation level 150% "2": Stall prevention operation level 180%	Pr. 7, Pr. 8
3	Optimum acceleration/ deceleration mode (Note 2, 4)	Optimum operation can be carried out by fully utilizing the inverter capabilities in the continuous rating range. Self-learning automatically sets the corresponding parameters so that the average current during acceleration/deceleration is equal to the rated current. Appropriate for applications where the load will not vary by a large amount.	Pr. 0, Pr. 7, Pr. 8
4	Energy-saving mode (Note 3, 5)	This operation mode tunes the output voltage online to minimize the inverter output power during constant-speed operation. Appropriate for energy-saving applications such as fan and pump.	Output voltage
5, 6	Elevator mode (Note 3)	Automatically controls the inverter output voltage to deliver the maximum torque in both the driving and regenerative modes. Appropriate for a counterbalanced elevator. "5": Stall prevention operation level 150% "6": Stall prevention operation level 180%	Pr. 0, Pr. 13, Pr. 19
7	Brake sequence	Mechanical brake opening completion signal input This function causes the inverter to output the mechanical brake operation timing signal for elevating application.	
8	mode	Mechanical brake opening completion signal not input For function details and related parameter setting, refer to Pr. 278 to Pr. 285 (brake sequence functions).	

- Note: 1. When more accurate control is required for your application, set the other parameters as appropriate.
 - Because of the learning system, this control is not valid at the first time in the optimum acceleration/deceleration mode. Also, this mode is only valid for frequency setting of 30.01Hz or more.
 - 3. When the advanced magnetic flux vector control has been selected using Pr. 80 and Pr. 81, the settings of the energy-saving mode and elevator mode are ignored. (Advanced magnetic flux vector control has higher priority.)
 - 4. If an overvoltage (OV3) trip has occurred during operation in the optimum acceleration/deceleration mode (setting "3"), re-set Pr. 8 "deceleration time" to a larger value and restart operation in this mode.
 - 5. When the "energy-saving mode" (setting "4") is used to decelerate the motor to a stop, the deceleration time may be longer than the preset value. Also, overvoltage is likely to occur in this mode as compared to the constant-torque load characteristics, set the deceleration time to a longer value.
 - 6. If the setting is "7" or "8" (brake sequence mode), Pr. 10 to Pr. 12 (DC dynamic braking) are made invalid.

Pr. 61 "reference current"

Related parameter -

Pr. 62 "reference current for acceleration"

Pr. 60 "intelligent mode selection"

Pr. 63 "reference current for deceleration"

Pr. 64 "starting frequency for elevator mode"

• Set these parameters to improve performance in the intelligent mode.

Parameter Number	Factory Setting	Setting Range	Remarks
61	9999	0 to 500A, 9999	9999: Referenced from rated inverter current.
62	9999	0 to 200%, 9999	
63	9999	0 to 200%, 9999	
64	9999	0 to 200%, 9999	

<Setting>

(1) Pr. 61 "reference current setting"

Setting	Reference Current
9999 (factory setting)	Referenced from rated inverter current
0 to 500A	Referenced from setting (rated motor current)

(2) Pr. 62 "reference current for acceleration"

(The reference value differs between the shortest acceleration/deceleration mode and optimum acceleration/deceleration mode.)

The reference current setting can be changed.

Setting	Reference Current	Remarks
9999 (factory setting)	150% (180%) is the limit value.	Shortest acceleration/deceleration mode
9999 (lactory setting)	100% is the optimum value.	Optimum acceleration/deceleration mode
	The setting of 0 to 200% is the limit value.	Shortest acceleration/deceleration mode
0 to 200%	The setting of 0 to 200% is the optimum value.	Optimum acceleration/deceleration mode

(3) Pr. 63 "reference current for deceleration"

(The reference value differs between the shortest acceleration/deceleration mode and optimum acceleration/deceleration mode.)

The reference current setting can be changed.

Setting	Reference Current	Remarks	
9999 (factory setting)	150% (180%) is the limit value.	Shortest acceleration/deceleration mode	
9999 (factory setting)	100% is the optimum value.	Optimum acceleration/deceleration mode	
	The setting of 0 to 200% is the limit value.	Shortest acceleration/deceleration mode	
0 to 200%	The setting of 0 to 200% is the optimum	Optimum acceleration/deceleration mode	
	value.		

(4) Pr. 64 "starting frequency for elevator mode"

Setting	Reference Current
9999 (factory setting)	2Hz is the starting frequency.
0 to 10Hz	The setting of 0 to 10Hz is the starting frequency.

Note: Pr. 61 to Pr. 64 are only valid when any of "1 to 6" is selected for Pr. 60.

Pr. 65 "retry selection"

Pr. 67 "number of retries at alarm occurrence"

Pr. 68 "retry waiting time"

Pr. 69 "retry count display erasure"

When an alarm occurs, the retry function causes the inverter to automatically reset itself to make a restart and continue operation. You can select whether retry is made or not, alarms reset for retry, number of retries made, and waiting time.

Parameter Number	Factory Setting	Setting Range
65	0	0 to 5
67	0	0 to 10, 101 to 110
68	1 s	0 to 10 s
69	0	0

<Setting>

Use Pr. 65 to select alarms to be reset for retry.

Errors Reset for Retry			Sett	ing		
Display	0	1	2	3	4	5
E.OC1	•	•		•	•	•
E.OC2	•	•		•	•	
E.OC3	•	•		•	•	•
E.OV1	•		•	•	•	
E.OV2	•		•	•	•	
E.OV3	•		•	•	•	
E.THM	•					
E.THT	•					
E.IPF	•				•	
E.UVT	•				•	
E.FIN						
E. BE	•				•	
E. GF	•				•	
E. LF						
E.OHT	•					
E.OLT	•				•	
E.OPT	•				•	
E.OP1	•				•	
E.OP2	•				•	
E.OP3	•				•	
E. PE	•				•	
E.PUE						
E.RET						
E.CPU						
E. 6						
E. 7						
E.MB1	•				•	
E.MB2	•				•	
E.MB3	•				•	
E.MB4	•				•	
E.MB5	•				•	
E.MB6	•				•	
E.MB7	•				•	
E.P24						
E.CTE						

Note: ● indicates the errors selected for retry.

Use Pr. 67 to set the number of retries at alarm occurrence.

Pr. 67 Setting	Number of Retries	Alarm Signal Output
0	Retry is not made.	
1 to 10	1 to 10 times	Not output.
101 to 110	1 to 10 times	Output.

- Use Pr. 68 to set the waiting time from when an inverter alarm occurs until a restart in the range 0 to 10 seconds.
- Reading the Pr. 69 value provides the cumulative number of successful restart times made by retry. The setting of "0" erases the cumulative number of times.
- Note: 1. The cumulative number in Pr. 69 is incremented by "1" when retry operation is regarded as successful, i.e. when normal operation is continued without any alarm occurring during a period more than four times longer than the time set in Pr. 68.
 - 2. If alarms occur consecutively within a period four times longer than the above waiting time, the operation panel (FR-DU04) may show data different from the most recent data or the parameter unit (FR-PU04) may show data different from the first retry data. The data stored as the error reset for retry is only that of the alarm which occurred the first time.
 - 3. When an inverter alarm is reset at the restart time, the stored data of the electronic overcurrent protection, regenerative brake duty, etc. are not cleared. (Different from the power-on reset.)

! CAUTION

! When you have selected the retry function, stay away from the motor and machine unless required. They will start suddenly (after the reset time has elapsed) after occurrence of an alarm.

When you have selected the retry function, apply the supplied CAUTION seals in easily visible places.

Pr. 66 → Refer to Pr. 22.

Pr. 70 → Refer to Pr. 30.

4

Pr. 71 "applied motor"

Set the motor used.

Parameter Number	Factory Setting	Setting Range
71	0	0 to 8, 13 to 18, 20, 23, 24

Related parameters

Pr. 0 "torque boost"

Pr. 12 "DC dynamic brake voltage"

Pr. 19 "base frequency voltage"

Pr. 60 "intelligent mode"

Pr. 80 "motor capacity"

Pr. 81 "number of motor poles"

Pr. 96 "auto tuning setting/status"

Pr. 100 to Pr. 109 "V/F frequency/voltage"

<Setting>

Refer to the following list and set this parameter according to the motor used.

Pr. 71	Thermal Characteristics of Electronic Overcurrent Protection			Мо	otor
Setting				Standard	Constant Torque
0	Thermal characteristics matching a standard	motor		0	
1	Thermal characteristics matching the constar	nt-torque motor			0
2	Thermal characteristics matching a standard 5-point flexible V/F characteristics	motor		0	
20	Unavailable for M4000 series				
3	Standard motor	Onland II a #II an and a femilia an antifemil		0	
13	Constant-torque motor	Select "offline auto tuning setting".			0
23	Unavailable for M4000 series				
4	Standard motor	Auto tuning read or change setting		0	
14	Auto tuning data can be read or set anew.	enabled			0
24	Unavailable for M4000 series	vailable for M4000 series			
5	Standard motor	Star connection		0	
15	Constant-torque motor	Star connection	Motor constants can		0
6	Standard motor	Delta connection	on be entered directly.	0	
16	Constant-torque motor	Della connection			0
7	Standard motor	Stor connection	B:	0	
17	Constant-torque motor	Star connection Direct motor			0
8	Standard motor	Delta connection	constant entry and offline auto tuning	0	
18	Constant-torque motor	Della connection	online auto turing		0

- Note: 1. When "9999" is set in Pr. 19, "2" cannot be set in Pr. 71. To set "2" in Pr. 71, set the appropriate value (other than "9999") in Pr. 19.
 - 2. When "2" is set in Pr. 71, Pr. 100 to Pr. 109 are displayed on the parameter unit (FR-PU04). In other settings, if any of Pr. 100 to Pr. 109 settings is changed, the new setting is not displayed in the "Default parameter list" and "Set parameter list".
 - 3. Refer to Pr. 96 for offline auto tuning.
 - 4. Set any of "3, 7, 8, 13, 17 and 18" to perform offline auto tuning.



Set this parameter correctly according to the motor used. Incorrect setting may cause the motor to overheat and burn.

Pr. 72 "PWM frequency selection"

Pr. 240 "Soft-PWM setting"

You can change the motor tone.

- By parameter setting, you can select Soft-PWM control which changes the motor tone.
- Soft-PWM control changes motor noise from a metallic tone into an unoffending complex tone.

Parameter Number	Factory Setting	Setting Range	Remarks
72	2	0 to 15	0: 0.7kHz, 15: 14.5kHz
240	1	0, 1	1: Soft-PWM valid

<Setting>

Refer to the following list and set the parameters:

Parameter Number	Factory Setting	Description
72	0 to 15	PWM carrier frequency can be changed. The setting displayed is in [kHz]. Note that 0 indicates 0.7kHz and 15 indicates 14.5kHz.
240	0	Soft-PWM invalid
240	1	When any of "0 to 5" is set in Pr. 72, Soft-PWM is made valid.

Note: 1. A reduced PWM carrier frequency will decrease inverter-generated noise and leakage current but increase motor noise.

- 2. If the PWM carrier frequency is increased to make noise low, continuous operation performed at more than the rated torque may generate motor noise, but it is not a failure.
- 3. When using Variable Torque Rating, maximum carrier frequency is 8KHz. (Setting: 8)

Pr. 73 "0-5V/0-10V selection"

Related parameters

Pr. 22 "stall prevention operation level"

Pr. 903 "frequency setting voltage bias"

Pr. 905 "frequency setting current gain"

You can select the analog input terminal specifications, the override function and the function to switch between forward and reverse rotation depending on the input signal polarity.

Parameter Number	Factory Setting	Setting Range
73	1	0 to 5, 10 to 15

<Setting>

Pr. 73	Terminal AU	Terminal 2	Terminal 1	Terminal 4 Input,	Override Function	Polarity
Setting	Signal	Input Voltage	Input Voltage	4 to 20mA	Override i dilettori	Reversible
0		*0 to 10V	0 to ±10V			
1		*0 to 5V	0 to ±10V		×	
2		*0 to 10V	0 to ±5V		^	No
3		*0 to 5V	0 to ±5V			(Note 3)
4		0 to 10V	*0 to ±10V		0	
5	OFF	0 to 5V	*0 to ±5V	Involid	0	
10	(No)	*0 to 10V	0 to ±10V	Invalid		
11		*0 to 5V	0 to ±10V		×	
12		*0 to 10V	0 to ±5V		^	Valid
13		*0 to 5V	0 to ±5V			Valid
14		0 to 10V	*0 to ±10V		0	
15		0 to 5V	*0 to ±5V		O	
0			0 to ±10V			
1		Invalid	0 to ±10V		×	
2		IIIVallu	0 to ±5V		^	No
3			0 to ±5V			(Note 3)
4		0 to 10V	lavalid		0	
5	ON	0 to 5V	Invalid	Yes	O	
10	(Yes)		0 to ±10V	*		
11		Invalid	0 to ±10V		×	
12		Invalid	0 to ±5V		^	Valid
13			0 to ±5V			Valid
14		0 to 10V	lavalid		0	
15		0 to 5V	Invalid		O	

Note: 1. The value of terminal 1 (frequency setting auxiliary input) is added to the main speed setting signal of terminal 2 or 4.

- 2. When override has been selected, terminal 1 or 4 is for the main speed setting and terminal 2 is for the override signal (50 to 150% at 0-5V or 0-10V).
- 3. Indicates that a negative-polarity frequency command signal is not accepted.
- 4. To change the maximum output frequency at the input of the maximum frequency command voltage (current), use the frequency setting voltage (current) gain, Pr. 903 (Pr. 905). At this time, the command voltage (current) need not be input. Also, the acceleration/deceleration time, which is a slope up/down to the acceleration/deceleration reference frequency, is not affected by the change in Pr. 73 setting.
- 5. When the Pr. 22 setting is "9999", the value of terminal 1 is for the stall prevention operation level setting.
- 6. * indicates the main speed setting.

Pr. 74 "filter time constant"

You can set the input section's internal filter constant of an external voltage or current frequency setting signal.

- Effective for eliminating noise in the frequency setting circuit.
- Increase the filter time constant if steady operation cannot be performed due to noise. A larger setting results in lower response. (The time constant can be set between approximately 1ms to 1s. with the setting of 0 to 8. A larger setting results in a larger filter time constant.)

Parameter Number	Factory Setting	Setting Range
74	1	0 to 8

Pr. 75 "reset selection/PU disconnection detection/PU stop selection"

You can select the reset input acceptance, PU (FR-DU04/FR-PU04) connector disconnection detection function and PU stop function.

Reset selection : You can select the reset function input timing.

PU disconnection detection : When it is detected that the PU (FR-DU04/FR-PU04) connector is

disconnected from the inverter for more than 1 second, the inverter outputs

an alarm code (E.PUE) and comes to an alarm stop.

• PU stop selection : When an alarm occurs in any operation mode, you can stop the motor from

the PU by pressing the [STOP] key.

Parameter Number	Factory Setting	Setting Range
75	14	0 to 3, 14 to 17

<Setting>

Pr. 75 Setting	Reset Selection	PU Disconnection Detection	PU Stop Selection	
0	Reset input normally enabled.	If the PU is disconnected, operation		
1	Reset input enabled only when the protective function is activated.	will be continued.	Pressing the [STOP] key decelerates	
2	Reset input normally enabled.	When the PU is disconnected, the	the motor to a stop only in the PU operation mode.	
3	Reset input enabled only when the protective function is activated.	inverter output is shut off.		
14	Reset input normally enabled.	If the DILie disconnected energies		
15	Reset input enabled only when the protective function is activated.	If the PU is disconnected, operation will be continued.	Pressing the [STOP] key decelerates	
16	Reset input normally enabled.	When the PU is disconnected, the inverter output is shut off.	the motor to a stop in any of the PU, external and communication operation modes.	
17	Reset input enabled only when the protective function is activated.	a inverter output is struct on.		

90

4

How to make a restart after a stop made by the [STOP] key from the PU during external operation

(1) Operation panel (FR-DU04)

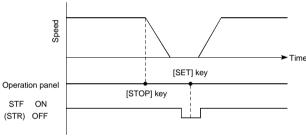
- 1) After completion of deceleration to a stop, switch off the STF or STR signal.
- 2) Press the [MODE] key two times* to call the TFT+ indication. (Note 8)

Note: When Pr. 79 = "3", press the [MODE] key three times, to display **PU**, then press the [DOWN] key and proceed to step 3).

- 3) Press the [SET] key.
- 4) Turn on the STF or STR signal.

(2) Parameter unit (FR-PU04)

- 1) After completion of deceleration to a stop, switch off the STF or STR signal.
- 2) Press the [EXT] key.
- 3) Switch on the STF or STR signal.



(Example) A restart after a stop during external operation

The other way of making a restart other than the above method is to perform a power-reset or to make a reset with the inverter reset terminal.

- Note: 1. By entering the reset signal (RES) during operation, the inverter shuts off output while it is reset, the data of the electronic overcurrent protection and regenerative brake duty are reset, and the motor coasts.
 - The PU disconnection detection function judges that the PU connector is disconnected when it is removed from the inverter for more than 1 second. If the PU had been disconnected before power-on, it is not judged as an alarm.
 - 3. To resume operation, reset the inverter after confirming that the PU is connected securely.
 - 4. When PU disconnection detection is set and the PU is then disconnected during PU jog operation, the motor decelerates to a stop. The motor will not stop if a PU disconnection alarm occurs.
 - 5. The Pr. 75 value can be set any time. Also, if parameter (all) clear is executed, this setting will not return to the initial value.
 - 6. When the motor is stopped by the PU stop function, PS is displayed but an alarm is not output. When the PU connector is used for RS-485 communication operation, the reset selection and PU stop selection functions are valid but the PU disconnection detection function is invalid.
 - 7. The reset key of the PU is only valid when the protective function is activated, independent of the Pr. 75 setting.



1 Do not reset the inverter with the start signal on.

Otherwise, the motor will start instantly after resetting, which may lead to hazardous conditions.

Pr. 76 "alarm code output selection"

Related parameters

Pr. 79 "operation mode selection"

Pr. 190 to Pr. 195 (multi-function outputs)

Pr. 200 to Pr. 231

"programmed operation"

When an alarm occurs, its code can be output as a 4-bit digital signal from the open collector output terminals. When programmed operation has been selected, this parameter also serves to output a group operation signal.

The alarm code can read by a programmable controller etc to show its remedy on a display. Also you can look at the progress of programmed operation.

Parameter Number	Factory Setting	Setting Range
76	0	0 to 3

<Setting>

Alarm code output

Dr. 76 Cotting	Output Terminals				
Pr. 76 Setting	SU	IPF	OL	FU	
0	Alarm code is not output. (Depends on Pr. 190 to Pr. 195.)				
1	Alarm code bit 3	Alarm code bit 2	Alarm code bit 1	Alarm code bit 0	
2	When an alarm occurs, an alarm code signal is output. (Output signal is the same as in 1.) When operation is normal, an operation status signal is output. (Output signal is the same as in 0.)				
3 (during programmed operation)	Output at time-out	During group 3 operation	During group 2 operation	During group 1 operation	

Note: 1. For alarm code definitions, refer to page 182.

2. The Pr. 76 setting overrides the Pr. 190 to Pr. 195 settings. Therefore, if you assign other signals to output terminals SU, IPF, OL and FU using Pr. 190 to Pr. 195, these terminals provide the output signals as listed above when any of "1 to 3" is set in Pr. 76. This should be noted when using the functions which use the output signals to exercise control.

Example: When using the brake sequence functions (Pr. 278 to Pr. 285), assign the brake opening request signal (BOF) to the RUN terminal by setting "20" in Pr. 190.

Pr. 77 "parameter write disable selection"

Related parameters

Pr. 79 "operation mode selection"

You can select between write-enable and disable for parameters. This function is used to prevent parameter values from being rewritten by accident.

Parameter Number	Factory Setting	Setting Range
77	0	0, 1, 2

<Setting>

Pr. 77 Setting	Function
0	Write enabled during a stop only.
Parameter values may only be written during a stop in the PU operation mod	
4	Write disabled.
' '	Values of Pr.75, Pr. 77 and Pr. 79 "operation mode selection" may be written.
2	Write enabled even during operation.

Note: 1. The values of the parameters half-tone screened in the parameter list can be set at any time. (Pr. 72 and Pr. 240 values cannot be set during external operation.)

2. If Pr. 77 = "2", the values of the following parameters cannot be written during operation. Stop operation when changing their parameter settings.

Parameter Number	Name	Parameter Number	Name
23	Stall prevention operation level at double speed	107	V/F4 (fourth frequency voltage)
48	Second stall prevention operation current	108	V/F5 (fifth frequency)
49	Second stall prevention operation frequency	109	V/F5 (fifth frequency voltage)
60	Intelligent mode selection	135	Commercial power supply-inverter switch-over sequence output terminal selection
61	Reference current	136	MC switch-over interlock time
66	Stall prevention operation reduction starting frequency	137	Start waiting time
71	Applied motor	138	Commercial power supply-inverter switch-over selection at alarm occurrence
79	Operation mode selection	139	Automatic inverter-commercial power supply switch-over frequency
80	Motor capacity	180	RL terminal function selection
81	Number of motor poles	181	RM terminal function selection
83	Rated motor voltage	182	RH terminal function selection
84	Rated motor frequency	183	RT terminal function selection
95	Advanced mode selection	184	AU terminal function selection
96	Auto tuning setting/status	185	JOG terminal function selection
100	V/F1 (first frequency)	186	CS terminal function selection
101	V/F1 (first frequency voltage)	190	RUN terminal function selection
102	V/F2 (second frequency)	191	SU terminal function selection
103	V/F2 (second frequency voltage)	192	IPF terminal function selection
104	V/F3 (third frequency)	193	OL terminal function selection
105	V/F3 (third frequency voltage)	194	FU terminal function selection
106	V/F4 (fourth frequency)	195	ABC terminal function selection

- 3. By setting "1" in Pr. 77, the following clear operations can be inhibited:
 - Parameter clear
 - All clear
 - User clear

Pr. 78 "reverse rotation prevention selection"

Related parameters

Pr. 79 "operation mode selection"

This function can prevent any reverse rotation fault resulting from the misoperation of the start signal.

Used for a machine which runs only in one direction, e.g. fan, pump.
 (The setting of this function is valid for the PU, external and communication operations.)

Parameter Number	Factory Setting	Setting Range
78	0	0 1 2

<Setting>

Pr. 78 Setting	Function	
0	Both forward and reverse rotations allowed	
1	Reverse rotation disallowed	
2	Forward rotation disallowed	

Pr. 79 "operation mode selection"

Related parameters

Pr. 15 "jog frequency"

Pr. 4 to Pr. 6, Pr. 24 to 27, Pr.232 to Pr.239 (multi-speed operation)

Pr. 76 "alarm code output selection"

Pr. 180 to Pr. 186 (input terminal function selection)

Pr. 200 to Pr. 231 (programmed operation)

Used to select the operation mode of the inverter.

You can choose any of the operation modes: operation using external signals (external operation), operation from the PU (FR-DU04/FR-PU04) (PU operation), combination of PU operation and external operation (external/PU combined operation), and computer link operation (when the FR-A5NR option is used).

Parameter Number	Factory Setting	Setting Range
79	0	0 to 8

<Setting>

Pr. 79 Setting	Function		
0	External operation mode is selected at power-on.		
0	PU or external operation can be selected.		
1	PU operation mode		
2	External operation mode		
3	External/PU combined operation mode 1 Running frequencySet from the PU (FR-DU04/FR-PU04) (direct setting, [UP/DOWN] key) or external		
	signal input (multi-speed setting only) Start signalExternal signal input (terminal STF, STR)		
4	External/PU combined operation mode 2 Running frequencyExternal signal input (terminal 2, 4, 1, jog, multi-speed selection) Start signalInput from the PU (FR-DU04/FR-PU04) ([FWD] key, [REV] key)		
5	Programmed operation mode You can set 10 different operation starting times, rotation directions and running frequencies for each of three groups. Operation startSTF Timer resetSTR Group selectionRH, RM, RL		
6	Switch-over mode Switch-over between PU operation, external operation and computer link operation (when the communication option such as the FR-A5NR is used) modes can be done while running.		
7	External operation mode (PU operation interlock) X12 signal ONMay be switched to PU operation mode (output stop during external operation) X12 signal OFFSwitching to PU operation mode inhibited		
8	Switching to other than external operation mode (disallowed during operation) X16 signal ONSwitched to external operation mode X16 signal OFFSwitched to PU operation mode		

Note: Either "3" or "4" may be set to select the PU/external combined operation. These settings differ in starting method.

(1) Programmed operation

With this function, you can set 10 different operation starting times, rotation directions and running frequencies individually for each of selected three groups to perform automatic operation under the control of the internal elapsed time counting timer. For full information of this function, refer to the explanations of

Pr. 200 to Pr. 231.

(2) Switch-over mode

You can select between PU operation, external operation and computer link operation (when FR-A5NR option is used).

Operation Mode Switching	Switching Operation/Operating Status		
External operation to PU operation	Select the PU operation mode. Rotation direction is the same as that of external operation. Set frequency is as set by the potentiometer (frequency setting potentiometer). (Note that the setting will disappear when power is switched off or the inverter is reset.)		
External operation to computer link operation	Mode change command to computer link mode is transmitted from the computer. Rotation direction is the same as that of external operation. Set frequency is as set by the potentiometer (frequency setting potentiometer). (Note that the setting will disappear when power is switched off or the inverter is reset.)		
PU operation to external operation	Press the external operation key of the parameter unit. Rotation direction is determined by the external operation input signal. Set frequency is determined by the external frequency setting signal.		
PU operation to computer link operation	Mode change command to computer link mode is transmitted from the computer. Rotation direction and set frequency are the same as those of PU operation.		
Computer link operation to external operation	The switch-over command to the external mode is sent from the computer. Rotation direction is determined by the external operation input signal. Set frequency is determined by the external frequency setting signal.		
Computer link operation to PU 1) Select the PU operation mode with the operation panel or parameter unit. • Rotation direction and set frequency are the same as those of computer link ope			

(3) PU operation interlock

When the PU operation interlock signal is switched off, the operation mode is forcibly changed to the external operation mode. This function prevents the inverter from being inoperative by the external command if the mode is accidentally left unswitched from the PU operation mode.

1) Preparation

- Set "7" in Pr. 79 (PU operation interlock).
- Using any of Pr. 180 to Pr. 186 (multi-function input terminal assignment), allocate the terminal used to input X12 (PU external interlock signal).
- When the X12 signal is not assigned, the function of the MRS signal changes from MRS (output stop) to PU external interlock.

2) Function

X12 (MRS) Signal	Function/Operation	
	Output stopped during external operation.	
ON	Operation mode can be switched to PU operation mode.	
ON	Parameter values can be rewritten in PU operation mode.	
	PU operation allowed.	
Forcibly switched to external operation mode.		
OFF	External operation allowed.	
	Switching to PU operation mode inhibited.	

<Function/operation changed by switching on-off the X12 (MRS) signal>

Operating	Operating Condition		Operation			Switching
Operation mode	Status	X12 (MRS) Signal	Mode (Note 4)	Operating Status	Parameter Write	to PU Operation Mode
	During stop	$ON \rightarrow OFF$ (Note 3)		During stop	$Allowed \to disallowed$	Disallowed
PU	During operation	ON → OFF (Note 3)	External	If external operation frequency setting and start signal are entered, operation is performed in that status.	Allowed $ ightarrow$ disallowed	Disallowed
	During stop	$OFF \to ON$		During stop	$Disallowed \to disallowed$	Allowed
Duning stop	$ON \to OFF$	External	During stop	$Disallowed \rightarrow disallowed$	Disallowed	
External During	$OFF \to ON$		Disallowed → disallowed	$Disallowed \to disallowed$	Disallowed	
	operation	$ON \to OFF$		During operation → output stop	${\sf Disallowed} \to {\sf disallowed}$	Disallowed

Note: 1. When the Pr. 79 setting is 7 and the PU operation interlock signal is OFF, network operation such as computer link cannot be used.

- 2. If the X12 (MRS) signal is on, the operation mode cannot be switched to the PU operation mode when the start signal (STF, STR) is on.
- 3. The operation mode switches to the external operation mode independently of whether the start signal (STF, STR) is on or off. Therefore, the motor is run in the external operation mode when the X12 (MRS) signal is switched off with either of STF and STR on.
- 4. When an alarm occurs, the inverter can be reset by pressing the [RESET] key of the operation panel.
- 5. When the MRS signal is used as the PU interlock signal, switching the MRS signal on and rewriting the Pr. 79 value to other than 7 in the PU operation mode causes the MRS signal to provide the ordinary MRS function (output stop). Also, as soon as 7 is set in Pr. 79, the MRS signal acts as a PU interlock signal.
- 6. When the MRS signal is used as the PU external interlock signal, the signal logic conforms to the Pr. 17 setting. When Pr. 17 = 2, read ON for OFF and OFF for ON in the above explanation.

(4) Operation mode external signal switching function

1) Preparation

Set "8" (switching to other than external operation mode) in Pr. 79. Using any of Pr. 180 to Pr. 186 (input terminal function selection), allocate the terminal used to input the X16 (PU-external operation switching) signal.

2) Function

When the X16 signal is switched on in the PU operation mode, the operation mode is forcibly changed to the external operation mode. When the X16 signal is switched off in the external operation mode, the operation mode is changed to the PU operation mode. When the X16 signal is switched off during network operation such as computer link, the operation mode is changed to the PU operation mode as soon as the switch-over command to the external operation mode is sent from the computer. Note that this switch-over may only be made while the inverter is at a stop and cannot be made during operation.

X16 Signal	Operation Mode	
ON	External operation mode (cannot be changed to the PU operation mode)	
OFF	PU operation mode (cannot be changed to the external operation mode)	

Note: When terminal assignment is changed using Pr. 180 to Pr. 186, the other functions may be affected. Check the functions of the corresponding terminals before making setting.

Pr. 80 "motor capacity"

Pr. 81 "number of motor poles"

Pr. 89 "speed control gain"

You can set the advanced magnetic flux vector control.

Advanced magnetic flux vector control
 Provides large starting torque and sufficient low-speed torque.
 Effective for great load fluctuation.

Related parameters

Pr. 71 "applied motor"

Pr. 83 "rated motor voltage"

Pr. 84 "rated motor frequency"

Pr. 89 "speed control gain"

Pr. 90 to Pr. 94 (motor constants)

Pr. 95 "online auto tuning selection"

Pr. 96 "auto tuning setting/status"

Pr. 180 to Pr. 186

(input terminal function selection)

Parameter Number	Factory Setting	Setting Range	Remarks
80	9999	0.4K to 55kW, 9999	9999: V/F control
81	9999	2, 4, 6, 12, 14, 16, 9999	9999: V/F control
89	100%	0 to 200.0%	

If any of the following conditions is not satisfied, faults such as torque shortage and speed fluctuation may occur. In this case, select V/F control.

<Operating conditions>

• The motor capacity is equal to or one rank lower than the inverter CT rating as the following table.

Inverter CT rating	One rank lower capacity than inverter	
0.75kW	0.4kW	
2.2kW	1.5kW	
3.7kW	2.2kW	
7.5kW	5.5kW	
15 kW	11 kW	
22 kW	18.5 kW	
37 kW	30 kW	
55 kW	45 kW	

- Offline auto tuning must be performed.
- The number of motor poles is any of 2, 4, and 6. (4 poles only for the constant-torque motor)
- Single-motor operation (one motor for one inverter) is performed.
- The wiring length between the inverter and motor is within 30m (98.42 feet). (If the length is over 30m (98.42 feet), perform offline auto tuning with the cables wired.)

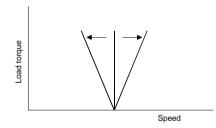
<Setting>

(1) Advanced magnetic flux vector control

 By setting the capacity, number of poles and type of the motor used in Pr. 80 and Pr. 81, the advanced magnetic flux vector control can be selected.

Parameter Number	Setting	Description		
80	9999	V/F control		
80	0.4 to 55	Set the motor capacity applied.	Advanced magnetic flux vector control	
	9999	V/F control		
	2, 4, 6	Set the number of motor poles.	Advanced magnetic flux vector control	
81	12,14,16	V/F control is selected when the X18 (magnetic flux-V/F switch-over) signal switches on. (This selection is not made during operation.) Use any of Pr. 180 to Pr. 186 to assign the terminal used for X18 signal input. 12: For 2-pole motor 14: For 4-pole motor 16: For 6-pole motor		

- When using constant-torque motor, set "1" in Pr. 71.
 - Note: 1. Speed fluctuation is slightly greater than in the V/F control. (Advanced magnetic flux vector control may not be suitable for machines which attach importance to little speed fluctuation at low speed, e.g. grinders, lapping machines.)
 - 2. When the terminal functions are changed using Pr. 180 to Pr. 186, the other functions may be affected. Confirm the functions of the corresponding terminals before making setting.
- For adjustment of motor speed fluctuation due to load variation
 Pr. 89 can be used to adjust motor speed fluctuation when the load varies.



Pr. 82 "motor exciting current"

Pr. 83 "rated motor voltage"

Pr. 84 "rated motor frequency"

Pr. 90 "motor constant (R1)"

Pr. 91 "motor constant (R2)"

Pr. 92 "motor constant (L1)"

Pr. 93 "motor constant (L2)"

Pr. 94 "motor constant (X)"

Related parameters

Pr. 7 "acceleration time"

Pr. 9 "electronic overcurrent protection"

Pr. 71 "applied motor"

Pr. 80 "motor capacity"

Pr. 81 "number of motor poles"

Pr. 95 "online auto tuning selection"

Pr. 156 "stall prevention operation selection"

Pr. 96 "auto tuning setting/status"

When you use the advanced magnetic flux vector control, you must perform the offline auto tuning operation to calculate motor constants automatically.

- Offline auto tuning is made valid only when other values than "9999" are set in Pr. 80 and Pr. 81 to select the advanced magnetic flux vector control.
- The offline tuning data (motor constants) can be copied to another inverter with the PU (FR-DU04/ FR-PU04).
- Offline auto tuning

Automatically measures the motor constants used for advanced magnetic flux vector control.

- Offline auto tuning can be performed with the load connected. (As the load is smaller, tuning accuracy is higher. Tuning accuracy does not change if inertia is large.)
- For the offline auto tuning, you can select either the motor non-rotation mode or rotation mode.
 Note that when making selection for the online auto tuning, the motor-only rotation mode should be selected.
- You can read, write and copy the motor constants tuned by the offline auto tuning.
- The offline auto tuning status can be monitored with the PU (FR-DU04/FR-PU04).

Parameter Number	Factory Setting	Setting Range	Remarks
82	9999	0 to, 9999	9999: standard motor
83	575V	0 to 1000V	Rated motor voltage
84	60Hz	50 to 120Hz	Rated motor frequency
90	9999	0 to, 9999	9999: standard motor
91	9999	0 to, 9999	9999: standard motor
92	9999	0 to , 9999	9999: standard motor
93	9999	0 to, 9999	9999: standard motor
94	9999	0 to , 9999	9999: standard motor
96	0	0, 1, 101	0: No tuning

<Operating conditions>

- The motor is connected.
- The motor capacity is equal to or one rank lower than the inverter capacity.
- The maximum frequency is 120Hz.
- Special motors such as high-slip motor and high-speed motor cannot be tuned.
- When "101" (offline auto tuning with motor running) is set in Pr. 96, note the following:
 - 1) Torque may not be enough during tuning.
 - 2) The motor may be run at nearly its rated frequency (Pr. 84 setting) without problem.
 - 3) The brake is open.
 - 4) No external force is applied to rotate the motor.
- If "1" (tuning without motor running) is set in Pr. 96, the motor may run slightly. Therefore, fix the motor securely with a mechanical brake, or before tuning, make sure that there will be no problem in safety if the motor runs.

This instruction must be followed especially for vertical lift applications.

Note that if the motor runs slightly, tuning performance is unaffected.

Note: Offline auto tuning will not be performed properly if it is performed when the reactor or surge voltage suppression filter is connected between the inverter and motor.

Remove it before starting tuning.

<Setting>

(1) Parameter setting

- Using Pr. 80 and Pr. 81, select the advanced magnetic flux vector control.
- Refer to the parameter details list and set the following parameters:
 - 1) Set "1" or "101" in Pr. 96.
 - For setting of "1" Tuning without motor running.
 - For setting of "101" Tuning with motor running.
 - 2) Set the rated motor current (A) in Pr. 9.
 - 3) Set the rated motor voltage (V) in Pr. 83.
 - 4) Set the rated motor frequency (Hz) in Pr. 84.
 - 5) Select the motor using Pr. 71.

 - Constant-torque motor......Pr. 71 = "13"

Note: Pr. 83 and Pr. 84 are only displayed when the advanced magnetic flux vector control is selected (Pr. 80, Pr. 81).

In these parameters, set the values given on the motor plate.

■ Parameter details

Parameter Number	Setting	Description				
9	0 to 500A	Set the rated motor current (A).				
	0	Electronic overcurrent protection thermal motor	Electronic overcurrent protection thermal characteristics suitable for general-purpose motor			
	1	Electronic overcurrent protection thermal motor	Electronic overcurrent protection thermal characteristics suitable for constant-torque motor			
	2	Electronic overcurrent protection thermal motor 5-point flexible V/F characteristics	characteristics suitabl	e for general-purpose		
	3	Standard motor	Select "offline auto	tuning cotting"		
	13	Constant-torque motor	Select offliffe auto	turning setting		
71 (Note 1)	4	Standard motor	Auto tuning read or change setting			
` ′	14	Constant-torque motor	enabled			
	5	Standard motor	Star connection	Discretisment of		
	15	Constant-torque motor	Star Connection	Direct input of motor constants enabled Direct input of		
	6	Standard motor	Delta connection			
	16	Constant-torque motor	Della connection			
	7	Standard motor	Star connection			
	17	Constant-torque motor	Star connection	motor constants		
	8	Standard motor	Delta connection	and offline auto tuning		
	18	Constant-torque motor	Della connection			
83	0 to 1000V	Set the rated motor voltage (V).				
84	50 to 120Hz	Set the rated motor frequency (Hz).				
90	0 to, 9999					
91	0 to, 9999					
92	0 to, 9999	Tuning data				
93	0 to , 9999	(Values measured by offline auto tuning are	e set automatically.)			
0.4	9999					
94	0 to 100%					
	0	Offline auto tuning is not performed.				
96 (Note 2)	1	Offline auto tuning is performed without mo	otor running.			
	101	Offline auto tuning is performed with motor running.				

Note: 1. The electronic overcurrent protection characteristics are also selected simultaneously.

2. Select "101" to increase tuning accuracy.

(2) Tuning execution

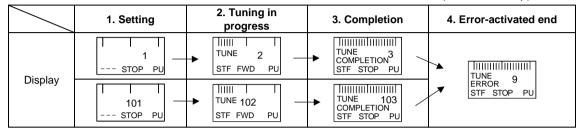
- For PU operation, press the [FWD] or [REV] key.
- For external operation, switch on the run command.
 - Note: 1. When "101" is set in Pr. 96, guard against hazards because the motor rotates.
 - 2. To force tuning to end
 - Switch on the MRS or RES signal or press the [STOP] key to end.
 - Switch off the tuning start command or make a forced stop.
 - 3. During offline auto tuning, the following I/O signals are only valid:
 - Input signals
 - STOP, OH, MRS, RT, CS, RES, STF, STR
 - Output signals
 - RUN, OL, IPF, FM, AM, A, B, C
 - 4. Special caution should be exercised when a sequence has been designed to open the mechanical brake with the RUN signal.
 - 5. When performing offline auto tuning, switch on the main circuit power (R, S, T) of the inverter and then enter the run command.

(3) Monitoring the offline tuning status

When the parameter unit (FR-PU04) is used, the Pr. 96 value is displayed during tuning on the main monitor as shown below. When the operation panel (FR-DU04) is used, only the same numerical value as on the PU is displayed:

Parameter unit (FR-PU04) main monitor

(For inverter trip)



Operation panel (FR-DU04) display

(For inverter trip)

	1. Setting		2. Tuning in progress		3. Completion	4. Error-activated end
Displayed	1 -	*	2	*	3	_
value	101	-	102	•	103	9

Reference: Offline auto tuning time (factory setting)

Offline Auto Tuning Setting	Time
1: No-rotation mode	Approximately 25 seconds
	Approximately 40 seconds
	(Offline auto tuning time varies with acceleration and deceleration time settings as
2: Rotation mode	indicated below:
	Offline auto tuning time = acceleration time + deceleration time + approximately 30
	seconds)

(4) Ending the offline auto tuning

- 1) Confirm the Pr. 96 value.
 - Normal end: "3" or "103" is displayed.
 - Error-activated end: "9", "91", "92" or "93" is displayed.
 - Forced end ... "8" is displayed.
- 2) When tuning ended normally.

For PU operation, press the [STOP] key. For external operation, switch off the start signal (STF or STR). This operation resets the offline auto tuning and the PU's monitor display returns to the ordinary indication. (Without this operation, next operation cannot be done.)

- 3) When tuning was ended due to an error.

 Offline auto tuning did not end normally. (Motor co
 - Offline auto tuning did not end normally. (Motor constants have not been set.) Reset the inverter and start tuning all over again.
- 4) Error display definitions.

Error Display	Error Cause	Remedy
9 Inverter trip		Re-set.
91	Current limit (stall prevention) function was activated.	Increase acceleration/deceleration time. Set "1" in Pr. 156.
92 Inverter output voltage reached 75% of rated value.		Check for fluctuation of power supply voltage.
93	Calculation error	Check the motor wiring and re-set.

No connection with motor will result in 93 error.

5) When tuning was forced to end

A forced end occurs when tuning is forced to end by pressing the [STOP] key or turning off the start signal (STF or STR) during tuning.

In this case, offline auto tuning was not brought to a normal end. (The motor constants are not yet set.) Reset the inverter and restart tuning.

- Note: 1. The motor constants measured once in the offline auto tuning are stored as parameters and their data is held until the offline auto tuning is performed again.
 - 2. An instantaneous power failure occurring during tuning will result in a tuning error. After power is restored, the inverter goes into the ordinary operation mode. Therefore, when STF (STR) is on, the motor runs in forward (reverse) rotation.
 - 3. When "8888" is set in Pr. 11, the tuning is forced to end and the DC dynamic brake is started upon input of the MRS signal.
 - 4. Any alarm occurring during tuning is handled as in the ordinary mode. Note that if an error retry has been set, retry is ignored.
 - 5. The set frequency monitor displayed during the offline auto tuning is 0Hz.

! CAUTION

- Note that the motor may start running suddenly.
- When the offline auto tuning is used in vertical lift application, e.g. a lifter, it may drop due to insufficient torque.

<Setting the motor constants as desired>

The motor constants (Pr. 90 to Pr. 94) may be set as desired in either of two ways; the data measured in the offline auto tuning is read and utilized or changed, or the motor constants are set without the offline auto tuning data being used.

- To utilize or change the offline auto tuning data <Operating procedure>
 - 1. Set "801" in Pr. 77. Only when the Pr. 80 and Pr. 81 settings are other than "9999", the parameter values of the motor constants (Pr. 90 to Pr. 94) can be displayed. Though the parameter values of other than the motor constants (Pr. 90 to Pr. 94) can also be displayed, they are parameters for manufacturer setting and should be handled carefully without misuse.
 - 2. Set any of the following values in Pr. 71:
 - 3. In the parameter setting mode, read the following parameters and set desired values. (Note 1)

Parameter Number	Name	Setting Range	Setting Increments	Factory Setting
82	Motor exciting current	0 to ****, 9999	1	9999
90	Motor constant R1	0 to ****, 9999	1	9999
91	Motor constant R2	0 to ****, 9999	1	9999
92	Motor constant L1	0 to ****, 9999	1	9999
93	Motor constant L2	0 to ****, 9999	1	9999
94	Motor constant X	0 to ****, 9999	1	9999

4. Return the Pr. 77 setting to the original value.

- Note: 1. Pr. 90 to Pr. 94 values may only be read when the Pr. 80 and Pr. 81 settings are other than "9999" (advanced magnetic flux vector control selected).
 - 2. Set "9999" in Pr. 90 to Pr. 94 to use the standard motor constants (including those for the constant-torque motor).
 - 3. Set "3" (standard motor) and "13" (constant-torque motor) in Pr. 71 to use the constants measured in the offline auto tuning. Set "4 and 14 in Pr. 71 and change the motor constants to change the values measured in the offline auto tuning.
 - 4. As the motor constants measured in the offline auto tuning have been converted into <u>internal data</u> (****), refer to the following setting example when making setting:

Setting example: To slightly increase Pr. 90 value

When Pr. 90 is displayed "2516", set 2642, i.e. 2516×1.05=2641.8, in Pr. 90.

(The value displayed has been converted into a value for internal use. Hence, simple addition of a given value to the displayed value has no significance.)

- To set the motor constants without using the offline auto tuning data The Pr. 92 and Pr. 93 motor constants may either be entered in $[\Omega]$ or in [mH]. Before starting operation, confirm which motor constant unit is used.
 - To enter the Pr. 92 and Pr. 93 motor constants in $[\Omega]$

<Operating procedure>

- 1. Set "801" in Pr. 77. Only when the Pr. 80 and Pr. 81 settings are other than "9999", the parameter values of the motor constants (Pr. 90 to Pr. 94) can be displayed. Though the parameter values of other than the motor constants (Pr. 90 to Pr. 94) can also be displayed, they are parameters for manufacturer setting and should be handled carefully without misuse.
- 2. Set any of the following values in Pr. 71:

		Star Connection Motor	Delta Connection Motor
Cotting	Standard motor	5	6
Setting	Constant-torque motor	15	16

3. In the parameter setting mode, read the following parameters and set desired values:

Parameter Number	Name	Setting Range	Setting Increments	Factory Setting
90	Motor constant R1	0 to 10Ω, 9999	0.001Ω	9999
91	Motor constant R2	0 to 10Ω, 9999	0.001Ω	9999
92	Motor constant X1	0 to 10Ω, 9999	0.001Ω	9999
93	Motor constant X2	0 to 10Ω, 9999	0.001Ω	9999
94	Motor constant X	0 to 500Ω, 9999	0.01Ω	9999

4. Refer to the following table and set Pr. 84:

Parameter Number	Name	Setting Range	Setting Increments	Factory Setting
84	Rated motor frequency	50 to 120Hz	0.01Hz	60Hz

5. Return the Pr. 77 setting to the original value.

Note: 1. Pr. 90 to Pr. 94 values may only be read when the Pr. 80 and Pr. 81 settings are other than "9999" (advanced magnetic flux vector control selected).

- 2. Set "9999" in Pr. 90 to Pr. 94 to use the standard motor constants (including those for the constant-torque motor).
- 3. If "star connection" is mistaken for "delta connection" or vice versa during setting of Pr. 71, advanced magnetic flux vector control cannot be exercised normally.

- To enter the Pr. 92 and Pr. 93 motor constants in [mH]
- <Operating procedure>
- 1. Set "801" in Pr. 77. Only when the Pr. 80 and Pr. 81 settings are other than "9999", the parameter values of the motor constants (Pr. 90 to Pr. 94) can be displayed. Though the parameter (Pr. 82 to Pr. 99) values of other than the motor constants (Pr. 90 to Pr. 94) can also be displayed, they are parameters for manufacturer setting and should be handled carefully without misuse.
- 2. Set any of the following values in Pr. 71:
- 3. In the parameter setting mode, read the following parameters and set desired values:

Parameter Number	Name	Setting Range	Setting Increments	Factory Setting
90	Motor constant R1	0 to 50Ω, 9999	0.001Ω	9999
91	Motor constant R2	0 to 50Ω, 9999	0.001Ω	9999
92	Motor constant L1	0 to 1000mH, 9999	0.1mH	9999
93	Motor constant L2	0 to 1000mH, 9999	0.1mH	9999
94	Motor constant X	0 to 100%, 9999	0.1%	9999

4. Refer to the following table and set Pr. 84:

Parameter Number	Name	Setting Range	Setting Increments	Factory Setting
84	Rated motor frequency	50 to 120Hz	0.01Hz	60Hz

- 5. Return the Pr. 77 setting to the original value.
- Note: 1. Pr.90 to Pr. 94 values may only be read when the Pr. 80 and Pr. 81 settings are other than "9999" (advanced magnetic flux vector control selected).
 - 2. Set "9999" in Pr. 90 to Pr. 94 to use the standard motor constants (including those for the constant-torque motor).

Pr. 89 → Refer to Pr. 80.

Pr. 95 "online auto tuning selection"

Related parameters -

Pr. 71 "applied motor"

Pr. 80 "motor capacity"

Pr. 81 "number of motor poles"

Pr. 83 "rated motor voltage"

Pr. 84 "rated motor frequency"

Pr. 89 "speed control gain"

Pr. 90 to Pr. 94 (motor constants)

Pr. 96 "auto tuning setting/status"

By online auto tuning, the motor conditions are tuned rapidly at the start. This enables precise operation unaffected by motor temperatures and steady high-torque operation down to super-low speed. After setting the Pr. 80 and Pr. 81 values, select online auto tuning with Pr. 95.

Online auto tuning

Use this function when steady high-torque operation is required for low-speed operation under advanced magnetic flux vector control.

Before starting the online auto tuning, perform the offline auto tuning. Data must be calculated.

PARAMETERS

Parameter Number	Factory Setting	Setting Range	Remarks
95	0	0, 1	1: Online auto tuning

<Operating conditions>

- Data required for online auto tuning is calculated in offline auto tuning. Before starting the operation of this function, always execute the offline auto tuning once more.
- Offline auto tuning should be carried out with "101" (motor running) set in Pr. 96 and with the motor disconnected from the load. (The motor may be connected with inertia load.)

<Operating procedure>

- 1) Read the Pr. 96 value and make sure that its setting is "3 or 103" (offline auto tuning complete).
- 2) Set "1" in Pr. 95 to select the online auto tuning.
- 3) Before starting operation, make sure that the following parameter values have been set:

Parameter Number	Description	
9	(Used as either the rated motor current or electronic overcurrent protection parameter)	
71	Applied motor	
80	Motor capacity (down to one rank lower, between 0.4kW and 55kW)	
81	Number of motor poles	

4) Give the run command in the PU or external operation mode.

- Note: 1. If any of the inverter starting conditions are not satisfied, e.g. when MRS is input, if the set frequency is lower than the starting frequency (Pr. 13) value, or during an inverter error, the online auto tuning is not activated.
 - 2. For a restart during deceleration or DC dynamic brake operation, the online auto tuning is not activated.
 - 3. The online auto tuning is invalid for programmed operation or jog operation.
 - 4. When automatic restart after instantaneous power failure is selected, it overrides the online auto tuning.
 - 5. For use in vertical lift application, examine the use of a brake sequence for brake opening timing at the start. Though the tuning ends in about a maximum of 500ms after a start, enough torque is not provided during that period. Therefore, note that the load may drop with gravity.
 - 6. Zero current detection and output current detection are also valid during the online auto tuning.
 - 7. The RUN signal is not output during the online auto tuning. The RUN signal switches on at a start.
 - 8. When programmed operation is selected (Pr. 79 = 5), the online auto tuning is invalid and is not executed.
 - 9. If the period between inverter stop and restart is within 4 seconds, the online auto tuning is executed but operation will not reflect the tuning results.
 - 10. Online auto tuning must not be selected when the closed loop vector function is operated with FR-A5AP option.

Pr. 96 → Refer to Pr. 82.

Pr. 100 "V/F1 (first frequency)"

Pr. 101 "V/F1 (first frequency voltage)"

Pr. 102 "V/F2 (second frequency)"

Pr. 103 "V/F2 (second frequency voltage)"

Pr. 104 "V/F3 (third frequency)"

Pr. 105 "V/F3 (third frequency voltage)"

Pr. 106 "V/F4 (fourth frequency)"

Pr. 107 "V/F4 (fourth frequency voltage)"

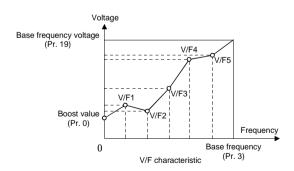
Pr. 108 "V/F5 (fifth frequency)"

Pr. 109 "V/F5 (fifth frequency voltage)"

You can make a dedicated V/F pattern by using V/F (frequency Voltage/Frequency) control to set V/F characteristics from the start to the basic frequency and basic voltage as desired.

 Desired V/F characteristics can be set by presetting V/F1 (first frequency voltage/first frequency), V/F2, V/F3, V/F4 and V/F5 in the corresponding parameters.

Parameter Number	Factory Setting	Setting Range	Remarks
100	9999	0 to 400Hz, 9999	
101	0	0 to 1000V	1
102	9999	0 to 400Hz, 9999]
103	0	0 to 1000V	Set "2" in Pr. 71 and a value
104	9999	0 to 400Hz, 9999	other than 9999 in Pr. 19.
105	0	0 to 1000V	These functions are not activated when any of "1 to
106	9999	0 to 400Hz, 9999	8" is set in Pr. 60.
107	0	0 to 1000V	0 13 361 111 1. 00.
108	9999	0 to 400Hz, 9999	
109	0	0 to 1000V	



<Setting>

(1) Confirm the settings of Pr. 19, Pr. 60 and Pr. 71.

Parameter Number	Description
19	Set the rated motor voltage.
19	This function is not activated if its value is "9999" and "8888" (factory setting).
60	Set "0" (ordinary operation mode).
71	Set "2" (V/F 5-point flexible characteristic).
·	

Related parameters

Pr. 19 "base frequency voltage"

Pr. 47 "second V/F (base frequency)"

Pr. 60 "intelligent mode selection"

Pr. 71 "applied motor"

Pr. 113 "third V/F (base frequency)"

- (2) Set the desired frequencies and voltages in Pr. 100 to Pr. 109.
 - The setting must satisfy the following relationship: F1≠F2≠F3≠F4≠F5≠Pr. 19 "base frequency".

If the set frequencies are the same, a write error occurs.

If any frequency setting is "9999", its point is ignored.

- Note: 1. The V/F 5-point flexible characteristic functions for V/F control only. It does not function for advanced magnetic flux vector control.
 - 2. The V/F 5-point flexible characteristic does not function when Pr. 60 is selected.
 - 3. The frequency voltage setting should be equal to or less than the Pr. 3 and Pr. 19 settings.
 - 4. Pr. 19 must be set. (When Pr. 19 = "9999", Pr. 71 cannot be set to "2" (5-point flexible V/F characteristic).)
 - 5. If "2" is set in Pr. 71, Pr. 47 and Pr. 113 do not function.
 - 6. When "2" is set in Pr. 71, the electronic overcurrent protection is calculated for a standard motor.

Pr. 110, Pr. 111 → Refer to Pr. 7.

Pr. 112 → Refer to Pr. 0.

Pr. 113 → Refer to Pr. 3.

Pr. 114, Pr. 115 → Refer to Pr. 48.

Pr. 116 → Refer to Pr. 42.

Pr. 117 "station number"

Pr. 118 "communication speed"

Pr. 119 "stop bit length/data length"

Pr. 120 "parity check presence/absence"

Pr. 121 "number of communication retries"

Pr. 122 "communication check time interval"

Pr. 123 "waiting time setting"

Pr. 124 "CR, LF presence/absence selection"

Used to perform required settings for RS-485 communication between the inverter and personal computer.

● The motor can be run from the PU connector of the inverter using RS-485 communication. Communication specifications

Conf	forming standard		RS-485		
Num	ber of inverters co	onnected	1:N (maximum 32 inverters)		
Com	munication speed		Selected between 19200, 9600 and 4800bps		
Cont	trol protocol		Asynchronous		
Com	munication metho	od	Half-duplex		
no S	Character system	m	ASCII (7 bits/8 bits) selectable		
atic	Stop bit length		Selectable between 1 bit and 2 bits.		
nic	Terminator		CR/LF (presence/absence selectable)		
Communication specifications	Chack custom Parity check		Selected between presence (even/odd) or absence		
mc ed:	Check system Sumcheck		Present		
Ōω	Waiting time set	ting	Selectable between presence or absence		

• For the data codes of the parameters, refer to the data code list in the appendices.

Parameter Number	Factory Setting	Setting Range		
117	0	0 1	to 31	
118	192	48, 96, 192		
119	1	Data length 8	0, 1	
119	'	Data length 7	10, 11	
120	2	0,	1, 2	
121	1	0 to 1	0, 9999	
122	0	0 to 999.	8 sec, 9999	
123	9999	0 to 150ms, 9999		
124	1	0.	1, 2	

<Setting>

To make communication between the personal computer and inverter, the communication specifications must be set to the inverter initially. If initial setting is not made or there is a setting fault, data transfer cannot be made.

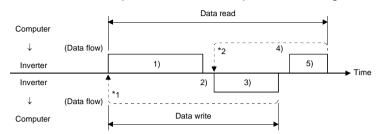
Note: After making the initial setting of the parameters, always reset the inverter. After you have changed the communication-related parameters, communication cannot be made if the inverter is not reset.

Parameter Number	Name	Settin	g	Description		
117	Station number	0 to 31		Station number specified for communication from the PU connector. Set the inverter station numbers when two or more inverters are connected to one personal computer.		
	Communi-	48		4800 baud		
118	cation	96		9600 baud		
	speed	192		19200 baud		
	Stop hit	8 bits	0	Stop bit length 1 bit		
119	Stop bit length/data	O DIIS	1	Stop bit length 2 bits		
113	length	7 bits	10	Stop bit length 1 bit		
	10.19.1	/ DITS	11	Stop bit length 2 bits		
	Parity check	0		Absent		
120	presence/	1 2		Odd parity present		
	absence			Even parity present		
	Number of	nmunica-		Set the permissible number of retries at occurrence of data receive error. If the number of consecutive errors exceeds the permissible value, the inverter will come to an alarm stop.		
121	communica- tion retries			If a communication error occurs, the inverter will not come to an alarm stop. At this time, the inverter can be coasted to a stop by MRS or RES input. During an error, the light fault signal (LF) is given to the open collector output. Allocate the used terminal with any of Pr. 190 to Pr. 195 (output terminal function selection).		
	Communi-	0		No communication		
122	cation	0.1 to 99	99.8	Set the communication check time [sec] interval.		
122	check time interval	9999)	If a no-communication state persists for longer than the permissible time, the inverter will come to an alarm stop.		
123	Waiting	aiting 0 to 150		Set the waiting time between data transmission to the inverter and response.		
120	time setting	9999		Set with communication data.		
	CR, LF	0		Without CR/LF		
124	presence/	1		With CR, Without LF		
121	absence selection	2		With CR/LF		

<Computer programming>

(1) Communication protocol

Data communication between the computer and inverter is performed using the following procedure:



- *1. If a data error is detected and a retry must be made, execute retry operation from the user program. The inverter comes to an alarm stop if the number of consecutive retries exceeds the parameter setting.
- *2. On receipt of a data error occurrence, the inverter returns "reply data 3)" to the computer again. The inverter comes to an alarm stop if the number of consecutive data errors reaches or exceeds the parameter setting.

(2) Communication operation presence/absence and data format types

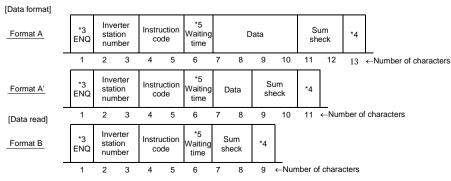
Communication operation presence/absence and data format types are as follows:

No.	Operation		Run Command	Running Frequency	Parameter Write	Inverter Reset	Monitoring	Parameter Read
1)	Communication request is sent to the inverter in accordance with the user program.		A'	Α	Α	Α	В	В
2)	Inverter data processin	g time	Present	Present	Present	Absent	Present	Present
	Reply data from the inverter (Data 1) is checked for error)	No error	С	С	С	Absent	E E'	Е
2)		Request accepted	C				E'	ı
3)		' I WITH ATTOT		D	D	Absent	F	F
4)	Computer processing of	lelay time	Absent	Absent	Absent	Absent	G	G
	Answer from	No error				Absent	_	_
5 \	computer in response	No processing	Absent	Absent	Absent		G	G
5)	5) to reply data 3) (Data 3) is checked for error)	With error data 3) is output	Absent	Absent	Absent	Absent	Н	Н

(3) Data format

Hexadecimal data is used. Data is automatically transferred in ASCII between the computer and inverter.

- 1) Data format types
 - (1) Communication request data from computer to inverter



Note: 1. The inverter station numbers may be set between H00 and H1F (stations 0 and 31) in hexadecimal.

- 2. *3 indicates the control code.
- 3. *4 indicates the CR or LF code.

When data is transmitted from the computer to the inverter, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must also be made from the inverter according to the computer.

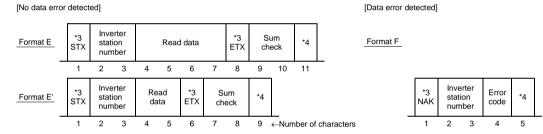
Also, the presence and absence of the CR and LF codes can be selected using Pr. 124.

4. *5: When Pr. 123 "waiting time setting" ≠ 9999, create the communication request data with no "waiting time" in the data format. (The number of characters decreases by 1.)

2) Send data from computer to inverter during data write



3) Reply data from inverter to computer during data read



4) Reply data from computer to inverter during data read



(4) Data definitions

1) Control codes

Signal	ASCII Code	Description
STX	H02	Start of Text (Start of data)
ETX	H03	End of Text (End of data)
ENQ	H05	Enquiry (Communication request)
ACK	H06	Acknowledge (No data error detected)
LF	H0A	Line Feed
CR	H0D	Carriage Return
NAK	H15	Negative Acknowledge (Data error detected)

2) Inverter station number

Specify the station number of the inverter which communicates with the computer.

3) Instruction code

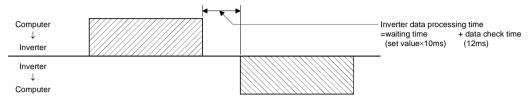
Specify the processing request (e.g. operation, monitoring) given by the computer to the inverter. Hence, the inverter can be run and monitored in various ways by specifying the instruction code as appropriate. (Refer to page 202)

4) Data

Indicates the data such as frequency and parameters transferred to and from the inverter. The definitions and ranges of set data are determined in accordance with the instruction codes. (Refer to page 202)

5) Waiting time

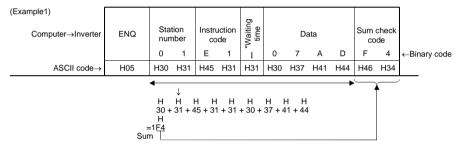
Specify the waiting time between the receipt of data at the inverter form the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150 ms in 10 ms increments (e.g. 1 = 10 ms, 2 = 20 ms).



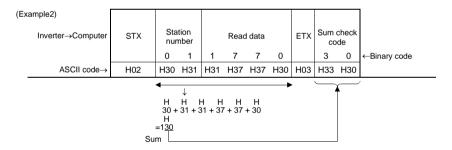
Note: If the Pr. 123 "waiting time setting" value is not 9999, create the communication request data with no "waiting time" in the data format. (The number of characters is decremented by 1.)

6) Sum check code

The sum check code is 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum (binary) derived from the checked ASCII data.



*When Pr. 123 "waiting time setting" \neq , 9999, create the communication request data with no "waiting time" in the data format. (The number of characters is decreased by 1.)



7) Error code

If any error is found in the data received by the inverter, its definition is sent back to the computer together with the NAK code. (Refer to page 117)

Note: 1. When the data from the computer has an error, the inverter will not accept that data.

- Any data communication, e.g. run command, monitoring, is started when the computer gives a communication request. Without the computer's command, the inverter does not return any data. For monitoring, therefore, design the program to cause the computer to provide a data read request as required.
- 3. Data for link parameter expansion setting differs as indicated below between access to Pr. 0 to Pr. 99 values and access to Pr. 100 to Pr. 905:

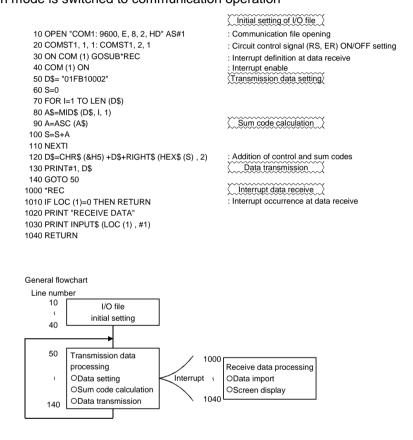
		Instruction Code	Data		
	Read	H7F	H00: Pr. 0 to Pr. 99 values are accessible.		
Link parameter expansion setting	Write	HFF	 H00: Pr. 0 to Pr. 99 values are accessible. H01: Pr. 100 to Pr. 159, Pr. 200 to Pr. 231 and Pr. 900 to Pr. 905 values are accessible. H02: Pr. 160 to Pr. 199 and Pr. 232 to Pr. 285 values are accessible. H03: Pr. 300 to Pr. 399 values are accessible. H09: Pr. 990 and Pr. 991 values are accessible. 		

PARAMETERS

Instructions for the program

- (1) When the operation mode is switched to communication operation.
- (2) Since any data communication, such as operation command or monitoring, is always requested by the computer, the inverter will not return data without the computer's request. Hence, design the program so that the computer gives a data read request for monitoring, etc. as required.
- (3) Program example

 When the operation mode is switched to communication operation



! CAUTION

- ① When the inverter's communication check time interval is not set, interlocks are provided to disable operation to prevent hazard. Always set the communication check time interval before starting operation.
- ⚠ Data communication is not started automatically but is made only when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc, the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter will come to an alarm stop (E.PUE).
 - The inverter can be coasted to a stop by switching on its RES signal or by switching power off.
- ! If communication is halted due to signal cable breakage, computer fault etc., the inverter does not detect such a fault. This should be fully noted.

<Setting items and set data>

After completion of parameter setting, set the instruction codes and data and start communication from the computer to allow various types of operation control and monitoring.

No.		Ite	m		uction ode			Des	scription	า		Number of Data Digits
1		Operation Read Write			H7B HFB		H0000: Communication option operation H0001: External operation H0002: Communication operation (PU connector) H0000: Communication option operation H0001: External operation					4 digits
		Output fre	equency	H	H0002: Communication operation (PU connector) H0000 to HFFFF: Output frequency (hexadecimal) in 0.01F increments [Speed (hexadecimal) in 1r/min increments if Pr. 37 = 1 increments in 1 increments if Pr. 37 = 1 increments in 1 increments					al) in 0.01Hz	4 digits	
		Output co	urrent	H	70		to HFFFF:				nal) in 0.1A	4 digits
		Output vo	oltage	Н	71	H0000 incren	to HFFFF: nents	Output	voltage	(hexadecir	mal) in 0.1V	4 digits
		Special n	nonitor	Н	72	H0000 HF3) to HFFFF: M	onitored	data se	lected by ins	struction code	4 digits
						H01	to H0E	Monito	r selectio	on data		
						Data	Description	Incre- ments	Data	Description	Incre- ments	
				Read	H73	H01	Output frequency	0.01Hz	H09	Regenerative brake	0.1%	
		Special monitor selection No.				H02	Output current	0.01A	H0A	Electronic overcurrent protection load factor	0.1%	2 digits
						H03	Output voltage	0.1V	H0B	Output current peak value	0.01A	İ
					HF3	H05	Frequency setting	0.01Hz	H0C	Converter outp voltage peak va		
						H06 H07		r/min 0.1%	H0D H0E	Input power Output power	0.01kW 0.01kW	
2	Monitoring	Monitoring				Read (Previo) to HFFFF: Tv data: [Example] ous alarm recent alarm	H30A0 THT) . OPT) b15 0 0 1		b8b7 0 0 1 0 1	bons bo o o o o o o o cent alarm HAO)	
						Ala	rm data	1	1			
		Alarm de	finition	H74 to	H77	Dat	<u> </u>	Data	Descript		Description	4 digits
						H0 H1	+	H51 H60	UVT OLT	HB1 HB2	PUE RET	
				1		H1		H70	BE	HC1	CTE	
						H1	+	H80	GF	HC2	P24	
						H2	+	H81	LF	HD5	MB1	
						H2	1 0V2	H90	OHT	HD6	MB2	
						H2	2 0V3	HA0	OPT	HD7	MB3	
						НЗ	0 THT	HA1	OP1	HD8	MB4	
						НЗ	1 THM	HA2	OP2	HD9	MB5	
						H4	+	HA3	OP3		MB6	
						H5	0 IPF	HB0	PE	HDB	MB7	

PARAMETERS

No.	Item		Instruction Code	Description	Number of Data Digits			
3	Run commar	nd	HFA	H00 to HFF: Run command b7				
4	Inverter statu monitor	us	H7A	H00 to HFF: Inverter status monitor b7 b0: Inverter running (RUN) * b1: Forward rotation b2: Reverse rotation b3: Up to frequency (SU) * b4: Overload (OL) * b5: Instantaneous power failure (IPF) * b6: Frequency detection (FU) * b7: Alarm occurrence *	2 digits			
5	Running free write (E ² PROM)	quency	HEE	H0000 to H9C40: 0.01Hz increments (hexadecimal) (0 to 400.00 Hz) To change the running frequency consecutively, write data to the inverter RAM. (Instruction code: HED)				
6	Inverter rese	et	HFD	H9696: Resets the inverter. As the inverter is reset on start of communication by the computer, the inverter cannot send reply data back to the computer.				
7	All clear		HFC	All parameters return to the factory settings. Any of four different clear operations is performed according to the data. Pr. Communication Pr. Calibration Other Pr. HF3 HFF H9696 O X O O H5A5A X X X O O H55AA X O O When all parameter clear is executed for H9696 or H9966, communication-related parameter settings also return to the factory settings. When resuming operation, set the parameters again.	4 digits			
8	User clear		HFC	H9669: User clear is made. Communication Pr. Calibration Other Pr. HF3 HFF X O X O	4 digits			
9	Parameter w	/rite	H80 to HE3	Refer to the data list (Refer to page 202) and write and/or read				
10	Parameter re	ead	H00 to H63	parameter values as required. Note that some parameters may not be accessible.	4 digits			
11	Link parameter expansion	Read	H7F	H00 to H6C and H80 to HEC parameter values are changed. H00: Pr. 0 to Pr. 99 values are accessible. H01: Pr. 100 to Pr. 159 , Pr. 200 to Pr. 231 and Pr. 900 to Pr. 905 values are accessible.	2 digits			
	setting	T TOZ. FL. 100 to FL. 199 and FL. 252 to FL. 200 values are accessible.						
10	Second parameter	Read	H6C	When setting the programmed operation (data code H3D to H5A, H8D to HAD) parameter H00: Time H01: Time H02: Rotation direction	2 digita			
12	changing (Code FF = 1)	Write	HEC	When setting the bias/gain (data code H5E to H6A, HDE to HED) parameter H00: Offset/gain H01: Analog H02: Analog value of terminal	2 digits			

<Error code List>

The corresponding error code in the following list is displayed if an error is detected in any communication request data form the computer.

Error Code	Item	Definition	Inverter Operation			
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than allowed number of retry times.				
H1	Parity error	The parity check result does not match the specified parity.	Donate to an alama atau			
H2	Sum check error	The sum check code in the computer does not match that of the data received by the inverter.	Brought to an alarm stop (E.PUE) if error occurs			
НЗ	Protocol error	Data received by the inverter is in the wrong protocol, data receive is not completed within the given time, or CR and LF are not as set in the parameter.	continuously more than the allowable number of retry times.			
H4	Framing error	The stop bit length is not as specified.				
H5	Overrun error	New data has been sent by the computer before the inverter				
H6						
H7	Character error	The character received is invalid (other than 0 to 9, A to F, control code).	Does not accept receive data but is not brought to alarm stop.			
H8						
H9						
НА	Mode error	Parameter write was attempted in other than the computer link operation mode or during inverter operation.	Does not accept or			
HB	Instruction code error	The specified command does not exist.	receive data but is not			
НС	Data range error Invalid data has been specified for parameter write, frequency setting, etc.		brought to alarm stop.			
HD						
HE						
HF						

(5) Communication specifications for RS-485 communication

		Operation Mode				
Operation Location	Item	Communication Operation from PU Connector	External Operation	Computer Link Operation (inboard option used)		
	Run command (start)	Enable	Disable	Disable		
0	Running frequency setting	Enable	Enable (Combined operation mode)	Disable		
Computer user program via	Monitoring	Enable	Enable	Enable		
PU connector	Parameter write	Enable (*4)	Disable (*4)	Disable (*4)		
	Parameter read	Enable	Enable	Enable		
	Inverter reset	Enable	Enable	Enable		
	Stop command (*3)	Enable	Enable	Enable		
	Run command	Disable	Disable	Enable (*1)		
	Running frequency setting	Disable	Disable	Enable (*1)		
	Monitoring	Enable	Enable	Enable		
Computer user program via	Parameter write	Disable (*4)	Disable (*4)	Enable (*4)		
inboard option	Parameter read	Enable	Enable	Enable		
	Inverter reset	Disable	Disable	Enable		
	Stop command (*3)	Enable	Enable	Enable		
	Inverter reset	Enable	Enable	Enable		
Control circuit terminal	Run command	Disable	Enable	Enable (*1)		
	Running frequency setting	Disable	Enable	Enable (*1)		

^(*1) As set in the operation and speed command write parameters.

(6) Operation at alarm occurrence

	Fault Location Description		Operation Mode			
Fault Location			Communication Operation (PU connector)	External Operation	Computer link Operation (inboard option used)	
	Inverter operation		Stop	Stop	Stop	
Inverter fault	Communication	PU connector	Continued	Continued	Continued	
	Communication	Inboard option	Continued	Continued	Continued	
Communication	Inverter operation		Stop/continued (*5)	Continued	Continued	
error		PU connector	Stop	Stop	Stop	
(Communication from PU connector)	Communication	Inboard option	Continued	Continued	Continued	
Communication	Inverter operation		Continued	Continued	Stop/continued (*6)	
error	Communication	PU connector	Continued	Continued	Continued	
(Inboard option)	Communication	Inboard option	Stop	Stop	Stop	

^(*5) Can be selected using the corresponding parameter (factory-set to continue)

(7) Communication error

Fault Location	Error Message
Communication error (Communication from PU connector)	E.PUE
Communication error (Inboard option)	E.OP1 to E.OP3

^(*2) At occurrence of RS-485 communication fault, the inverter cannot be reset from the computer.

^(*3) As set in Pr. 75.

^(*4) As set in Pr. 77.

^(*6) Can be selected using the corresponding parameter (factory-set to stop)

Pr. 128 "PID action selection"

Pr. 129 "PID proportional band"

Pr. 130 "PID integral time"

Pr. 131 "upper limit"

Pr. 132 "lower limit"

Pr. 133 "PID action set point for PU operation"

Pr. 134 "PID differential time"

Related parameters

Pr. 73 "0-5V/0-10V selection"

Pr. 79 "operation mode selection"

Pr. 180 to Pr. 186

(input terminal assignment)

Pr. 191 to Pr. 194

(output terminal assignment)

Pr. 902 to Pr. 905

(frequency setting voltage (current) biases and gains)

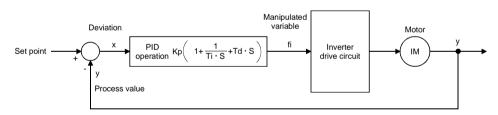
The inverter can be used to exercise process control, e.g. flow rate, air volume or pressure.

• The voltage input signal (0 to ±5V or 0 to ±10V) or Pr. 133 setting is used as a set point and the 4 to 20mADC current input signal used as a feedback value to constitute a feedback system for PID control.

Parameter Number	Factory Setting	Setting Range	Remarks
128	10	10, 11, 20, 21	
129	100%	0.1 to 1000%, 9999	9999: No proportional control
130	1 s	0.1 to 3600 s, 9999	9999: No integral control
131	9999	0 to 100%, 9999	9999: Function invalid
132	9999	0 to 100%, 9999	9999: Function invalid
133	0%	0 to 100%	
134	9999	0.01 to 10.00 s, 9999	9999: No differential control

<Setting>

(1) Basic PID control configuration



Kp: Proportional constant Ti: Integral time S: Operator Td: Differential time

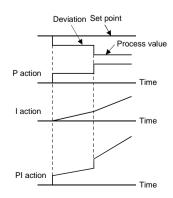
(2) PID action overview

1) PI action

A combination of proportional control action (P) and integral control action (I) for providing a manipulated variable in response to deviation and changes with time.

[Operation example for stepped changes of process value]

Note: PI action is the sum of P and I actions.



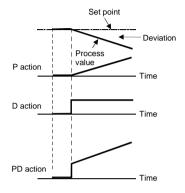
PARAMETERS

2) PD action

A combination of proportional control action (P) and differential control action (D) for providing a manipulated variable in response to deviation speed to improve the transient characteristic.

[Operation example for proportional changes of process value]

Note: PD action is the sum of P and D actions.



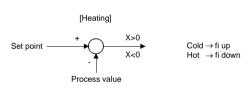
3) PID action

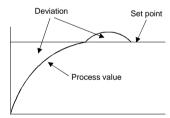
The PI action and PD action are combined to utilize the advantages of both actions for control.

Note: The PID action is the sum of P and I and D actions.

4) Reverse action

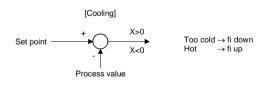
Increases the manipulated variable (output frequency) if deviation X (set point - process value) is positive, and decreases the manipulated variable if deviation is negative.

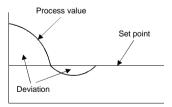




5) Forward action

Increases the manipulated variable (output frequency) if deviation X (set point - process value) is negative, and decreases the manipulated variable if deviation is positive.



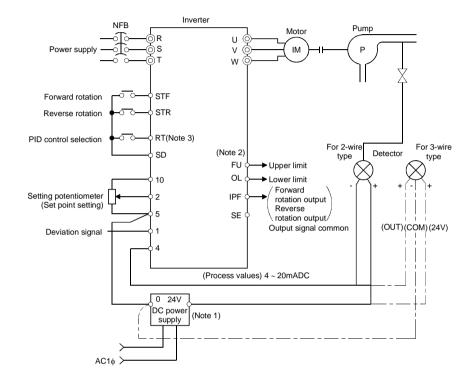


Relationships between deviation and manipulated variable (output frequency)

	Devi	ation
	Positive	Negative
Reverse action	7	Ä
Forward action	u	7

(3) Wiring example

- · Sink logic
- Pr. 183 = 14
- Pr. 192 = 16
- Pr. 193 = 14
- Pr. 194 = 15



- Note: 1. The power supply must be selected in accordance with the power specifications of the detector used.
 - 2. The output signal terminals used depends on the Pr. 191 to Pr. 194 settings.
 - 3. The input signal terminals used depends on the Pr. 180 to Pr. 186 settings.

(4) I/O signals

Signal		Terminal Used	Function	Description	Remarks	
	X14	Depending on Pr. 180 to Pr. 186	PID control selection	Switch on X14 to select PID control.	Set any of "10, 1 and 21" in Pr. 128.	1, 20
=	2	2	Set point input	Enter the set point for PID control.		
Input	1	1	Deviation signal input	Enter the deviation signal calculated externally.		
	4	4	Process value input	Enter the 4-20mADC process value signal from the detector.		
	FUP		Upper limit output	Output to indicate that the process value signal exceeded the upper limit value.	(Dr. 429 20 24)	
	FDN	Depending on	Lower limit output	Output to indicate that the process value signal exceeded the lower limit value.	(Pr. 128 = 20, 21)	collector output
Output	RL	Pr. 190 to Pr. 195	Forward (reverse) rotation direction output	"Hi" is output to indicate that the output indication of the parameter unit is forward rotation (FWD) or "Low" to indicate that it is reverse rotation (REV) or stop (STOP).	(Pr. 128 = 10, 11, 20, 21)	Open colle
	SE	SE	Output terminal common	Common to terminals FUP, FDN and RL		

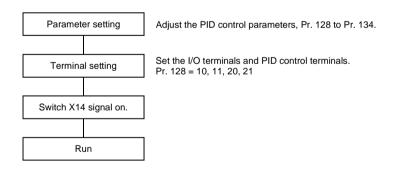
- To start PID control, switch on the X14 signal. When this signal is off, ordinary inverter operation is performed without the PID action being performed.
- Enter the set point across inverter terminals 2-5 or into Pr. 133 and enter the process value signal across inverter terminals 4-5.
- When entering the externally calculated deviation signal, enter it across terminals 1-5. At this time, set "10" or "11" in Pr. 128.

Item	Entry	Description		
Cot point	Across terminals 2-5	Set 0V as 0% and 5V as 100%.	When "1, 3, 5, 11, 13 or 15" is set in Pr. 73 (5V selected for terminal 2).	
Set point	Across terminals 2-5	Set 0V as 0% and 10V as 100%.	When "0, 2, 4, 10, 12 or 14" is set in Pr. 73 (10V selected for terminal 2).	
Set point	Pr. 133	Set the set point (%) in Pr. 133.		
Deviation	Across terminals 1-5	Set -5V as -100%, 0V as 0% and +5V as +100%.	When "2, 3, 5, 12, 13 or 15" is set in Pr. 73 (5V selected for terminal 1).	
signal		Set -10V as -100%, 0V as 0% and +10V as +100%.	When "0, 1, 4, 10, 11 or 14" is set in Pr. 73 (10V selected for terminal 1).	
Process value	Across terminals 4-5	4mADC is equivalent to 0% and 20mADC to 1	00%.	

(5) Parameter setting

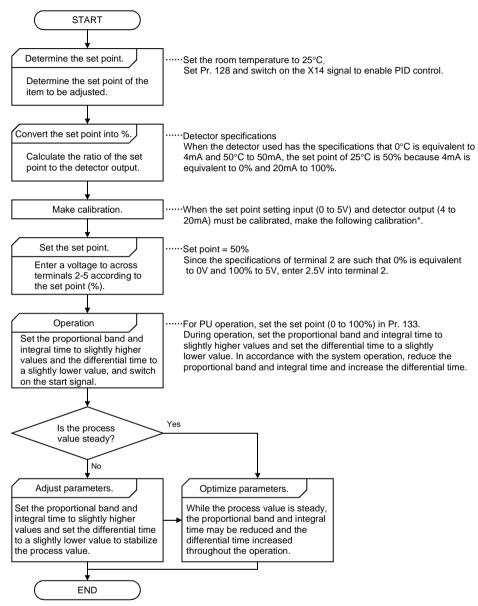
Parameter Number	Setting	Name	Description				
	10		For heating, pressure control, etc.	Deviation value	PID reverse action		
128	11	PID action	For cooling, etc.	(terminal 1)	PID forward action		
120	20	selection	For heating, pressure control, etc.	Process value input	PID reverse action		
	21		For cooling, etc.	(terminal 4)	PID forward action		
129	0.1 to 1000%	PID proportional band	If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the process value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, e.g. hunting occurs. Gain Kp = 1/proportional band				
	9999		No proportional control				
130	0.1 to 3600 s PID integral time		Time required for the integral (I) action to provide the same manipulated variable as that for the proportional (P) action. As the integral time decreases, the set point is reached earlier but hunting occurs more easily.				
	9999		No integral control.				
131	0 to 100%	Upper limit	Set the upper limit. If the feedback value exceeds the setting, the FUP signal is output. (Process value of 4mA is equivalent to 0% and 20mA to 100%.)				
	9999		No function				
132	0 to 100%	Lower limit	Set the lower limit. (If the process alarm can be output. In this case, 0% and 20mA to 100%.)	•	0 0 ,		
	9999		No function				
133	0 to 100%	PID action set point for PU operation	Only valid for the PU command in the PU operation or PU/external combined mode. For external operation, the voltage across 2-5 is the set point. (Pr. 902 value is equivalent to 0% and Pr. 903 value to 100%.)				
134	0.01 to 10.00 s	PID differential time	Time only required for the differential (D) action to provide the same process value as that for the proportional (P) action. As the differential time increases, greater response is made to a deviation change.				
	9999		No differential control.				

(6) Adjustment procedure



(7) Calibration example

(A detector of 4mA at 0°C and 20mA at 50°C is used to adjust the room temperature to 25°C under PID control. The set point is given to across inverter terminals 2-5 (0-5V).)



*When calibration is required, use Pr. 902 to Pr. 905 to calibrate the detector output and set point setting input in the PU mode during an inverter stop.

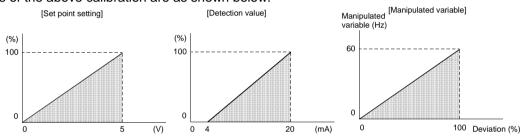
<Set point input calibration>

- 1. Apply the input voltage of 0% set point setting (e.g. 0V) to across terminals 2-5.
- 2. Make calibration using Pr. 902. At this time, enter the frequency which should be output by the inverter at the deviation of 0% (e.g. 0Hz).
- 3. Apply the voltage of 100% set point setting (e.g. 5V) to across terminals 2-5.
- 4. Make calibration using Pr. 903. At this time, enter the frequency which should be output by the inverter at the deviation of 100% (e.g. 60Hz).

<Detector output calibration>

- 1. Apply the output current of 0% detector setting (e.g. 4mA) to across terminals 4-5.
- 2. Make calibration using Pr. 904.
- 3. Apply the output current of 100% detector setting (e.g. 20mA) to across terminals 4-5.
- 4. Make calibration using Pr. 905.

Note: The frequencies set in Pr. 904 and Pr. 905 should be the same as set in Pr. 902 and Pr. 903. The results of the above calibration are as shown below:



Note: 1. If the multi-speed (RH, RM, RL) signal or jog operation (jog) signal is entered with the X14 signal on, PID control is stopped and multi-speed or jog operation is started.

- 2. When "20" or "21" is set in Pr. 128, note that the input across inverter terminals 1-5 is added to the set point across terminals 2-5.
- 3. When "5" (programmed operation mode) is selected for Pr. 79, PID control operation cannot be performed. In this setting, programmed operation is performed.
- 4. When "6" (switch-over mode) is selected for Pr. 79, PID is made invalid.
- When "9999" is set in Pr. 22, the stall prevention level is the value entered from terminal 1. When using terminal 1 as the edit input terminal for PID, therefore, set a value other than "9999" in Pr. 22.
- 6. When "1" (online auto tuning) is selected for Pr. 95, PID control is made invalid.
- When the terminal functions are changed using Pr. 180 to Pr. 186 and/or Pr. 190 to Pr. 195, the
 other functions may be affected. Confirm the functions of the corresponding terminals before
 making settings.
- 8. When you have chosen the PID control, the minimum frequency is as set in Pr. 902 and the macximum frequency is as set in Pr. 903.
 - (The settings of Pr. 1 "maximum frequency" and Pr. 2 "mimimum frequency" are also valid.)

Pr. 135 "commercial power supply-inverter switch-over sequence output terminal selection"

Pr. 136 "MC switch-over interlock time"

Pr. 137 "start waiting time"

Pr. 138 "commercial power supply-inverter switch-over selection at alarm occurrence"

Pr. 139 "automatic inverter-commercial power supply switch-over frequency"

Related parameters

Pr. 11 "DC dynamic brake operation time"

Pr. 57 "restart coasting time"

Pr. 58 "restart cushion time"

Pr. 180 to Pr. 186

(input terminal function selection)

Pr. 190 to Pr. 195

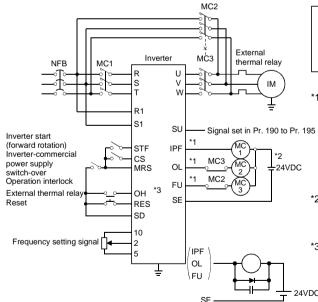
(output terminal function selection)

The inverter contains a complicated sequence circuit for commercial power supply-inverter operation switchover. Hence, the magnetic contactors for switch-over can be interlocked easily by merely entering the start, stop or automatic switch-over select signal.

Parameter Number	Factory Setting	Setting Range	Remarks
135	0	0, 1	
136	0.1 sec.	0 to 100.0 sec.	
137	0.5 sec.	0 to 100.0 sec.	
138	0	0,1	
139	9999	0 to 60.0Hz, 9999	9999: No automatic switch-over

(1) Wiring example

Sink logic, Pr. 185 = 7, Pr. 186 = 6, Pr. 192 = 17, Pr. 193 = 18, Pr. 194 = 19



Note: • This switch-over function is used in the external operation mode. Always connect terminals R1, S1 to a different power supply (power supply different from the one for MC1) to ensure proper operation.

MC2 and MC3 must be mechanically interlocked.

*1. Note the sequence output terminal capacities. The terminals used depend on the Pr. 190 to Pr. 194 settings.

Output Terminal Capacity	Permissible Output Terminal Load
Inverter's open collector outputs (IPF, OL, FU)	24VDC 0.1A
FR-A5AR (option output)	230VAC 0.3A 30VDC 0.3A

*2. When connecting an AC power supply, connect the FR-A5AR option and use the contact output. When connecting a DC power supply, install the following protective

*3. The terminals used depend on the Pr. 180 to Pr. 186 settings.

Roles of the magnetic contactors (MC1, MC2, MC3)

Magnetic Contactor	Place of Installation	Role
MC1	Between power supply and inverter	Normally shorted with the following exception: Opened only when an inverter fault occurs (shorted again by resetting)
MC2	Between power supply and motor	Shorted for commercial power supply operation, opened for inverter operation Shorted when an inverter fault occurs (selected with parameter, except for external thermal relay operation)
MC3	Between inverter output and motor	Shorted for inverter operation, opened for commercial power supply operation Opened when an inverter fault occurs

<I/O signals>

1) When this function is used (Pr. 135 = "1"), the input signals are switched on-off as indicated below:

Cianal	Tarminal Hood	Function	On-Off	MC Oper	ation (O: ON	, ×: OFF)
Signai	Signal Terminal Used Function		On-On	MC1	MC2	MC3
MRS	MRS	Operation	Commercial power supply- inverter operation enable ON	0	_	_
INIKO	WING	enable/disable selection	Commercial power supply- inverter operation disable OFF	0	×	Unchanged
CS	Depending on Pr. 180 to Pr.186	Inverter-commercial power supply switch-	Inverter operation ON Commercial power supply	0	×	0
	F1. 100 to F1.100	over	operationOFF	0	0	×
STF	STF	Inverter operation command (invalid for	Forward (reverse) rotationON	0	×	0
(STR)	(STR)	commercial power supply) (Note)	StopOFF	0	×	0
ОН	Depending on	External thermal relay	Motor normalON	0	_	
ОП	Pr. 180 to Pr.186	input	Motor faultOFF	×	×	×
RES	RES	Operating condition	InitializationON	Unchanged	×	Unchanged
INLO	INLO	initialization	Normal operation .OFF	0	_	_

- Note: In the above MC Operation field, [-] indicates that MC1 is on, MC2 is off and MC3 is on in inverter operation and MC1 is on, MC2 is off and MC3 is off in commercial power supply operation. [Unchanged] indicates that the status before signal-on or -off is held.
 - The CS signal only functions when the MRS signal is on. STF (STR) only functions when MRS and CS are on.
 - MC1 switches off when an inverter fault occurs.
 - If the MRS signal is not switched on, neither commercial power supply nor inverter operation can be performed.
- 2) The output signals are output as follows:

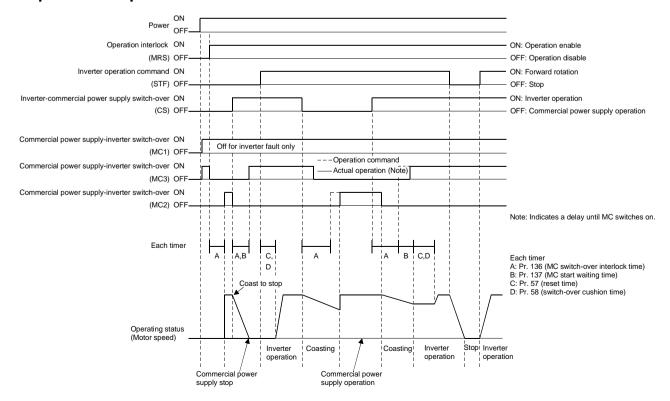
Signal	Terminal Used	Description
MC1	Depending on Pr. 190 to Pr. 195	MC1's operation signal is output
MC2		MC2's operation signal is output
MC3		MC3's operation signal is output

(2) Parameter setting

Parameter Number	Name	Setting	Description			
135	Commercial power supply-inverter switch-over sequence output terminal selection	0	Sequence output is not provided. (Pr. 136, Pr. 137, Pr. 138 and Pr. 139 settings are ignored.)			
		1	Sequence output is provided. When MC1 to MC3 are assigned with Pr. 190 to Pr. 195 (output terminal function selection), open collector outputs are provided. When they are not assigned, relay outputs are provided from the FR-A5AR (option).			
136	MC switch-over interlock time	0 to 100.0 s	Sets the MC2 and MC3 operation interlock time.			
137	Start waiting time	0 to 100.0 s	Set a slightly longer (about 0.3 to 0.5 s) value than the time from when the ON signal enters inverter operation MC3 to when it actually switches on.			
138	Commercial power supply-inverter switch-over selection at alarm occurrence	0	Stops inverter operation and coasts the motor. The inverter stops when an inverter fault occurs (both MC2 and MC3 switcoff).			
		1	Stops inverter operation and automatically switches inverter operation to commercial power supply operation. When an inverter fault occurs, inverter operation is automatically switched to commercial power supply operation (MC2: ON, MC3: OFF).			
139	Automatic inverter- commercial power supply switch-over frequency	0 to 60.0Hz	The motor is started and run by the inverter up to the set frequency, and when the output frequency reaches or exceeds the set frequency, inverter operation is automatically switched to commercial power supply operation. Start and stop are controlled by the inverter operation command (STF or STR).			
		9999	Automatic switch-over is not done.			

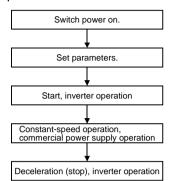
- Note: 1. Pr. 139 functions when Pr. 135 setting is other than "0".
 - 2. When the motor started by the inverter reaches the automatic switch-over frequency, inverter operation is switched to commercial power supply operation. If the inverter's run command value is then lowered to or below the switch-over frequency, commercial power supply operation is not automatically switched to inverter operation.
 - Switch off the inverter operation command signal (STF or STR) to switch commercial power supply operation to inverter operation and decelerate the motor to a stop.

<Operation sequence>



(3) Operation procedure

 Operation procedure for running Operation pattern



- Pr. 135 = "1" (inverter's open collector output terminals)
- Pr. 136 = "2.0 s"
- Pr. 137 = "1.0 s" (Set the value equal to or longer than the time from when MC3 switches on actually until the inverter and motor are connected. If it is shorter, restart may not function properly.
- Pr. 57 = "0.5 s"
- Pr. 58 = "0.5 s" (Always set this parameter when commercial power supply operation is switched to inverter operation.)

2) Signal on-off after parameter setting

	MRS	cs	STF	MC1	MC2	MC3	Remarks
Power on	OFF (OFF)	OFF (OFF)	OFF (OFF)	OFF ON (OFF ON)	OFF (OFF)	OFF ON (OFF ON)	External operation mode (PU operation mode)
At start (Inverter)	OFF ON	OFF ON	OFF ON	ON	OFF	ON	
Constant speed (Commercial power supply)	ON	ON OFF	ON	ON	OFF ON	ON OFF	After MC3 switches off, MC2 switches on. (Motor coasts during this period.) Waiting time 2 seconds.
Switched to inverter operation for deceleration (Inverter)	ON	OFF ON	ON	ON	ON OFF	OFF ON	After MC2 switches off, MC3 switches on. (Motor coasts during this period.) Waiting time 4 seconds.
Stop	ON	ON	ON OFF	ON	OFF	ON	-

- Note: 1. This function is only activated when R1 and S1 are connected to a different power supply (power supply which is not connected to MC1).
 - 2. This function is only valid in the external operation or PU (speed command) and external (run command) operation mode when the Pr. 135 value is other than "0". When the Pr. 135 value is other than "0" in the operation mode other than the above, MC1 and MC3 switch on.
 - 3. MC3 is on when the MRS and CS signals are on and STR is off, but when the motor run by the commercial power supply was coasted to a stop at the last time, it restarts after the time set in Pr. 137 has elapsed.
 - 4. Inverter operation is enabled when the MRS, STF and CS signals switch on. In other cases (MRS is on), commercial power supply operation is performed.
 - When the CS signal is switched off, the motor is switched over to commercial power supply operation. Note that when the STF (STR) signal is switched off, the motor is decelerated to a stop by the inverter.
 - 6. When both MC2 and MC3 are off and MC2 or MC3 is then switched on, the motor restarts after the waiting time set in Pr. 136 has elapsed.
 - If the Pr. 135 setting is other than 0, the Pr. 136 and Pr. 137 settings are ignored in the PU operation mode.
 Also, the inverter's input terminals (STF, CS, MRS, OH) return to their ordinary functions.
 - 8. When the commercial power supply-inverter switch-over sequence is selected, the PU operation interlock function (Pr. 79 = 7) is not activated if it has been set.
 - When the terminal functions are changed using Pr. 180 to Pr. 186 and/or Pr. 190 to Pr. 195, the
 other functions may be affected. Confirm the functions of the corresponding terminals before
 making settings.

Pr. 140 to Pr. 143 → Refer to Pr. 29.

Pr. 144 - Refer to Pr. 37.

Pr. 148. Pr. 149 → Refer to Pr. 22.

Pr. 150 "output current detection level"

Pr. 151 "output current detection time"

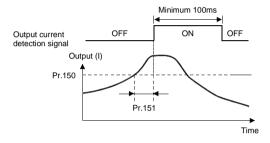
- Related parameters

Pr. 190 to Pr. 195 (output terminal function selection)

• If the output current remains higher than the Pr. 150 setting during inverter operation for longer than the time set in Pr. 151, the output current detection signal (Y12) is output from the inverter's open collector output terminal.

(Use any of Pr. 190 to Pr. 195 to assign the terminal used for Y12 signal output.)

Parameter Number	Factory Setting	Setting Range	
150	150%	0 to 200.0%	
151	0	0 to 10 s	



<Setting>

Refer to the following list and set the parameters:

Parameter Number	Description	
150	Set the output current detection level. 100% is the rated inverter current.	
151	Set the output current detection time. Set a period of time from when the output current rises to or above the Pr. 150 setting to when the output current detection signal (Y12) is output.	

Note: 1. Once switched on, the output current detection signal is held on for at least 100ms.

- 2. This function is also valid during execution of the online or offline auto tuning.
- 3. When the terminal functions are changed using Pr. 190 to Pr. 195, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

PARAMETERS

Pr. 152 "zero current detection level"

Pr. 153 "zero current detection time"

Related parameters

Pr. 190 to Pr. 195 (output terminal function selection)

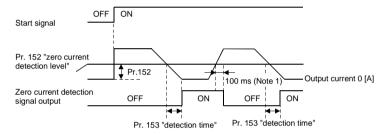
When the inverter's output current falls to "0", torque will not be generated. This may cause a gravity drop when the inverter is used in vertical lift application.

To prevent this, the output current "zero" signal can be output from the inverter to close the mechanical brake when the output current has fallen to "zero".

• If the output current remains lower than the Pr. 152 setting during inverter operation for longer than the time set in Pr. 153, the zero current detection (Y13) signal is output from the inverter's open collector output terminal.

(Use any of Pr. 190 to Pr. 195 to assign the terminal used for Y13 signal output.)

Parameter Number	Factory Setting	Setting Range	
152	5.0%	0 to 200.0%	
153	0.5 s	0 to 1 s	



<Setting>

Refer to the following list and set the parameters:

Parameter Number	Description
152	Set the zero current detection level. Set this parameter to define the percentage of the rated current at which the zero current will be detected.
153	Set the zero current detection time. Set a period of time from when the output current drops to or below the Pr. 152 setting to when the zero current detection signal (Y13) is output.

- Note: 1. If the current falls below the preset detection level but the timing condition is not satisfied, the zero current detection signal is held on for about 100ms.
 - 2. This function is also valid during execution of the online or offline auto tuning.
 - 3. When the terminal functions are changed using Pr. 190 to Pr. 195, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

!CAUTION

- The zero current detection level setting should not be too high, and the zero current detection time setting not be too long. Otherwise, the detection signal may not be output when torque is not generated at a low output current.
- To prevent the machine and equipment from resulting in hazardous conditions by use of the zero current detection signal, install a safety backup such as an emergency brake.

Pr. 155 "RT signal activated condition selection"

Related parameters

Pr. 14 "load pattern selection"

Pr. 44 to Pr. 49

(second function selection)

Pr. 81 "number of motor poles"

Pr. 180 to Pr. 186

(input terminal function selection)

• Set the condition of activating the RT terminal to select the second control functions by switching on-off the RT signal.

Parameter Number	Factory Setting	Setting Range
155	0	0, 10

<Setting>

Refer to the following table and set the parameter:

Pr. 155 Setting	Description	
0	Made valid immediately by switching the RT signal on-off.	
10	Made valid only when the RT signal is on at constant speed. (Invalid during acceleration/deceleration)	

Pr. 156 "stall prevention operation selection"

Related parameters

Pr. 22 "stall prevention operation level"

Pr. 23 "stall prevention operation level at double speed"

Pr. 47 "second stall prevention operation current"

Pr. 48 "second stall prevention operation frequency"

Pr. 114 "third stall prevention operation current"

Pr. 115 "third stall prevention operation frequency"

Pr. 154 "voltage reduction selection during stall prevention operation"

Pr. 157 "OL signal output waiting time"

You can make a setting to disable stall prevention caused by overcurrent, make a setting to disable the fast-response current limit (which limits the current to prevent the inverter from resulting in an overcurrent trip if an excessive current occurs due to sudden load variation or ON-OFF, etc. in the output side of the running inverter), and set the OL signal output delay.

Parameter Number	Factory Setting	Setting Range	
156	0	0 to 31, 100, 101	

<Setting>

Refer to the following table and set the parameter as required:

Pr. 156 Setting	Fast-Response Current Limit OActivated		Stall Prevention OActivated •Not activated		OL Signal Output OOperation continued •Operation not
	Not activated	Acceleration	Constant speed	Deceleration	continued (Note 1)
0	0	0	0	0	0
1	•	0	0	0	0
2	0	•	0	0	0
3	•	•	0	0	0
4	0	0	•	0	0
5	•	0	•	0	0
6	0	•	•	0	0
7	•	•	•	0	0
8	0	0	0	•	0
9	•	0	0	•	0
10	0	•	0	•	0
11	•	•	0	•	0
12	0	0	•	•	0
13	•	0	•	•	0
14	0	•	•	•	0
15	•	•	•	•	0
16	0	0	0	0	•
17	•	0	0	0	•
18	0	•	0	0	•
19	•	•	0	0	•
20	0	0	•	0	•
21	•	0	•	0	•
22	0	•	•	0	•
23	•	•	•	0	•
24	0	0	0	•	<u> </u>
25 26	0	0	0		
27	•		0		
28	0	0	•		
29	•	0	•	•	•
30	0	•	•	•	•
31	•	•	•	•	•
Driving	0	0	0	0	0
Regenerative	•	•	•	•	0
101 Driving	•	0	0	0	0
Regenerative	•	•	•	•	0

Note 1: When "Operation not continued for OL signal output" is selected, the "E.OLT" alarm code (stopped by stall prevention) is displayed and operation stopped.

(Alarm stop display "E.OLT")

Note 2: If the load is heavy, the lift is predetermined, or the acceleration/deceleration time is short, the

Note 2: If the load is heavy, the lift is predetermined, or the acceleration/deceleration time is short, the stall prevention may be activated and the motor not stopped in the preset acceleration/deceleration time. Therefore, set optimum values to the Pr. 156 stall prevention operation level.

(When the output voltage reduces during stall prevention operation, an overcurrent trip will be less liable to occur but the torque decreases. Set "0" in Pr. 154 when the torque may be reduced.)

! CAUTION

! Always perform test operation.

Stall prevention operation performed during acceleration may increase the acceleration time.

Stall prevention operation performed during constant speed may cause sudden speed changes.

Stall prevention operation performed during deceleration may increase the deceleration time, increasing the deceleration distance.

Pr. 157 "OL signal output waiting time"

Related parameters

Pr. 190 "RUN terminal function selection"

Pr. 191 "SU terminal function selection"

Pr. 192 "IPF terminal function selection"

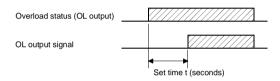
Pr. 193 "OL terminal function selection"

Pr. 194 "FU terminal function selection"

Pr. 195 "ABC terminal function selection"

Use this parameter to set whether the overload alarm signal (OL signal) is output immediately or a preset period of time after occurrence of an overload status.

Parameter Number	Factory Setting	Setting Range	Remarks
157	0	0 to 25 s, 9999	9999: No signal output



<Setting>

Refer to the following table and set the parameter:

Pr. 157 Setting	Description
0	Output immediately.
0.1 to 25	Output after the set time t (seconds) have elapsed.
9999	Overload alarm signal is not output.

Pr. 158 → Refer to Pr. 54.

Pr. 160 "user group read selection"

Pr. 173 "user group 1 registration"

Pr. 174 "user group 1 deletion"

Pr. 175 "user group 2 registration"

Pr. 176 "user group 2 deletion"

From among all parameters, a total of 32 parameters can be registered to two different user groups.

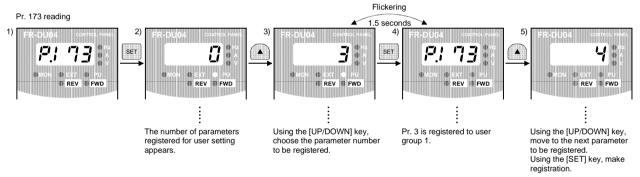
The registered parameters may only be accessed for reading and writing.

Other parameters than those registered to the user groups cannot be read.

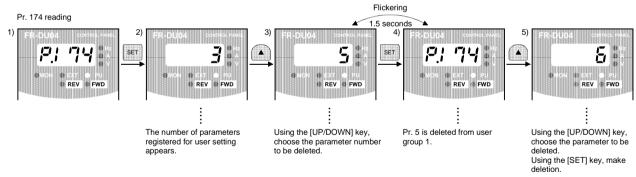
Parameter Number	Factory Setting	Setting Range	Remarks
160	0	0, 1, 10, 11	
173	0	0 to 999	
174	0	0 to 999, 9999	9999: Batch deletion
175	0	0 to 999	
176	0	0 to 999, 9999	9999: Batch deletion

<Examples of use>

(1) Parameter registration to user group (when registering Pr. 3 to user group 1)



(2) Parameter deletion from user group (when deleting Pr. 5 from user group 1)



(3) By setting the required value in Pr. 160, make the user groups valid or invalid.

Pr. 160 Setting	Description	
0	All parameters can be accessed for reading and writing (Factory setting)	
1	Parameters registered to user group 1 may only be accessed for reading and writing.	
10	Parameters registered to user group 2 may only be accessed for reading and writing.	
11	Parameters registered to user groups 1 and 2 may only be accessed for reading and writing.	

Note: 1. Pr. 77, Pr. 160 and Pr. 991 values can always be read independently of the user group setting.

- 2. When Pr. 173 or Pr. 174 is read, the number of parameters registered to user group 1 appears. When Pr. 175 or Pr. 176 is read, the number of parameters registered to user group 2 appears.
- 3. "0" set in the second digit of the 2-digit Pr. 160 setting is not displayed. However, it is displayed when "0" is set in the first digit only.
- When "9999" is set in Pr. 174 or Pr. 176, the parameters registered to the corresponding user group is batch-deleted.

Pr. 170 "watt-hour meter clear"

Pr. 171 "actual operation hour meter clear"

- Related parameter -

Pr. 52 "DU/PU main display data selection"

You can clear the watt-hour value and actual operation hour monitoring function.

Parameter Number	Factory Setting	Setting Range
170	0	0
171	0	0

<Setting>

Write "0" in the parameters to clear the watt-hour value and actual operation hour.

Pr. 173 to Pr. 176 → Refer to Pr. 160.

Pr. 180 "RL terminal function selection"

Pr. 181 "RM terminal function selection"

Pr. 182 "RH terminal function selection"

Pr. 183 "RT terminal function selection"

Pr. 184 "AU terminal function selection"

Pr. 185 "JOG terminal function selection"

Pr. 186 "CS terminal function selection"

Use these parameters to select/change the input terminal functions.

Parameter Number	Terminal Symbol	Factory Setting	Factory-Set Terminal Function Setting Range	
180	RL	0	Low-speed operation command (RL)	0 to 20, 22, 23, 9999
181	RM	1	Middle-speed operation command (RM)	0 to 20, 22, 23, 9999
182	RH	2	High-speed operation command (RH)	0 to 20, 22, 23, 9999
183	RT	3	Second function selection (RT)	0 to 20, 22, 23, 9999
184	AU	4	Current input selection (AU)	0 to 20, 22, 23, 9999
185	JOG	5	Jog operation selection (JOG)	0 to 20, 22, 23, 9999
186	cs	6	Automatic restart after instantaneous power failure selection (CS)	0 to 20, 22, 23, 9999

<Setting>

Refer to the following list and set the parameters:

Setting	Signal Name		Functions	Relevant Parameters
		Pr. 59 = 0	Low-speed operation command	Pr. 4 to Pr. 6 Pr. 24 to Pr. 27 Pr. 232 to Pr. 239
0	RL	Pr. 59 = 1, 2 *	Remote setting (setting clear)	Pr. 59
		Pr. 79 = 5 *	Programmed operation group selection	Pr. 79, Pr. 200, Pr. 201 to Pr. 210, Pr. 211 to Pr. 220, Pr. 221 to Pr. 230, Pr. 231
		Pr. 270 = 1, 3 *	Stop-on-contact selection 0	Pr. 270, Pr. 275, Pr. 276
		Pr. 59 = 0	Middle-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
1	RM	Pr. 59 = 1, 2 *	Remote setting (deceleration)	Pr. 59
		Pr. 79 = 5 *	Programmed operation group selection	Pr. 79, Pr. 200, Pr. 201 to Pr. 210, Pr. 211 to Pr. 220, Pr. 221 to Pr. 230, Pr. 231
		Pr. 59 = 0	High-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
2	RH	Pr. 59 = 1, 2 *	Remote setting (acceleration)	Pr. 59
		Pr. 79 = 5 *	Programmed operation group selection	Pr. 79, Pr. 200, Pr. 201 to Pr. 210, Pr. 211 to Pr. 220, Pr. 221 to Pr. 230, Pr. 231
3	RT	Second function selecti	ion	Pr. 44 to Pr. 50
3	KI	Pr.270 = 1, 3 *	Stop-on-contact selection 1	Pr. 270, Pr. 275, Pr. 276
4	AU	Current input selection		Refer to page 11
5	JOG	Jog operation selection		Pr. 15, Pr. 16
6	cs	selection	instantaneous power failure	Pr. 57, Pr. 58, Pr. 162 to Pr. 165
7	ОН		nput** I overheat protection thermal relay, erature relay or the like is operated	Refer to page 172
8	REX	15-speed selection (cor	mbination with RL, RM, RH)	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
9	X9	Third function		Pr. 110 to Pr. 116
10	For manufa Do not set.	cturer's.		
11 12	X12	Dil operation external i	ntoriook	Pr. 79
13	X12 X13	PU operation external i External DC dynamic b		Pr. 10 to Pr. 12
14	X13	PID control valid termin	· ·	Pr. 128 to Pr. 134
15	BRI	Brake opening complet		Pr. 278 to Pr. 285
16	X16	PU-external operation s	•	Pr. 79
17	X10 X17	· · · · · · · · · · · · · · · · · · ·	forward/reverse rotation boost	Pr. 14
18	X17	<u> </u>	x vector-V/F switch-over	Pr. 80, Pr. 81, Pr. 89
19	X10	Load torque high-speed frequency		Pr. 271 to Pr. 274
20	X20		deceleration C switch-over terminal	Pr. 380 to Pr. 383
22	X22	· ·	Note 11) (only when FR-A5AP	Pr. 350 to Pr. 369
23	LX		(only when FR-A5AP option is fitted)	Pr. 80, Pr.81, Pr. 359, Pr. 369, Pr. 370
9999		No function	,	

^{*:} When Pr. 59 = "1" or "2", Pr. 79 = "5", and Pr. 270 = "1" or "3" the functions of the RL, RM, RH and RT signals change as listed above.

^{**:} Operated when the relay contact "opens".

PARAMETERS

Note: 1. One function can be assigned to two or more terminals. In this case, the terminal inputs are OR'ed.

- 2. The speed command priorities are higher in order of jog, multi-speed setting (RH, RM, RL) and AU.
- 3. When advanced magnetic flux vector-V/F switch-over and load pattern selection forward/reverse rotation boost are not selected, the second functions (RT) share these functions.
- 4. Use common terminals to assign programmed operation group selection, multi-speeds (7 speeds) and remote setting. They cannot be set individually.
 - (Common terminals are used since these functions are designed for speed setting and need not be set at the same time.)
- 5. Stop-on-contact control selection, Pr. 270 = "1 or 3", shares RT with multi-speed setting (low speed), and its allocation cannot be changed.
- 6. When "7" is set in Pr. 79 and the PU operation external interlock (X12) signal is not assigned, the MRS signal acts as this function.
- 7. When the load pattern selection forward/reverse rotation boost (X17) signal is not assigned, the RT signal shares this function.
- 8. When advanced magnetic flux vector-V/F switch-over (X18) signal is not assigned, the RT signal shares this function.
- 9. When a stop position is entered externally for orientation control, the FR-A5AX (12-bit digital input) is required.
- 10. Made valid when vector control servo lock is set valid.

Related parameter -

Pr. 76 "operation mode selection"

Pr. 190 "RUN terminal function selection"

Pr. 191 "SU terminal function selection"

Pr. 192 "IPF terminal function selection"

Pr. 193 "OL terminal function selection"

Pr. 194 "FU terminal function selection"

Pr. 195 "ABC terminal function selection"

You can change the functions of the open collector and contact output terminals.

Parameter Number	Terminal Symbol	Factory Setting	Factory-Set Terminal Function	Setting Range
190	RUN	0	Inverter running	0 to 20, 25 to 33, 98 to 116, 120, 125 to 133, 198, 199
191	SU	1	Up to frequency	0 to 20, 25 to 33, 98 to 116, 120, 125 to 133, 198, 199
192	IPF	2	Instantaneous power failure/undervoltage	0 to 20, 25 to 33, 98 to 116, 120, 125 to 133, 198, 199
193	OL	3	Overload alarm	0 to 20, 25 to 33, 98 to 116, 120, 125 to 133, 198, 199
194	FU	4	Frequency detection	0 to 20, 25 to 33, 98 to 116, 120, 125 to 133, 198, 199
195	A, B, C	99	Alarm output	0 to 20, 25 to 33, 98 to 116, 120, 125 to 133, 198, 199

<Setting>

Refer to the following table and set the parameters:

Setting		Signal			Related
Positive logic	Negative logic	Name	Function	Operation	parameter
0	100	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above the starting frequency.	
1	101	SU	Up to frequency	Refer to Pr. 41 "up-to-frequency sensitivity". (Note 2)	Pr. 41
2	102	IPF	Instantaneous power failure or undervoltage	Output when an instantaneous power failure or undervoltage occurs.	
3	103	OL	Overload alarm	Output while stall prevention function is activated.	Pr. 22, Pr. 23, Pr. 66, Pr. 148, Pr.1, Pr. 149, Pr. 154
4	104	FU	Output frequency detection	Refer to Pr. 42, Pr. 43 (output frequency detection).	Pr. 42, Pr. 43
5	105	FU2	Second output frequency detection	Refer to Pr. 50 (second output frequency detection).	Pr. 50
6	106	FU3	Third output frequency detection	Refer to Pr. 116 (third output frequency detection).	Pr. 116
7	107	RBP	Regenerative brake pre-alarm	Output when 85% of the regenerative brake duty set in Pr. 70 is reached.	Pr. 70
8	108	THP	Electronic overcurrent protection pre-alarm	Output when the cumulative electronic overcurrent protection value reaches 85% of the preset level.	Pr. 9
9	109	PRG	Programmed mode	Output in the programmed mode. (Note 3)	Pr. 79, Pr. 200 to Pr. 231
10	110	PU	PU operation mode	Output when the PU operation mode is selected.	Pr. 17
11	111	RY	Inverter operation ready	Output when the inverter can be started by switching the start signal on or while it is running.	
12	112	Y12	Output current detection	Refer to Pr. 150 and Pr. 151 (output current detection).	Pr. 150, Pr. 151
13	113	Y13	Zero current detection	Refer to Pr. 152 and Pr. 153 (zero current detection).	Pr. 152, Pr. 153
14	114	FDN	PID lower limit	Refer to Pr. 128 to Pr. 134 (PID control).	
15	115	FUP	PID upper limit		Pr. 128 to
16	116	RL	PID forward-reverse rotation output		Pr. 134

Set	Setting				Related
Positive logic	Negative logic	Signal Name	Function	Operation	parameter
17		MC1	Commercial power supply- inverter switch-over MC1	Refer to Pr. 135 to Pr.139 (commercial power supply-inverter switch-over).	
18		MC2	Commercial power supply- inverter switch-over MC2		Pr. 135 to Pr. 139
19		МС3	Commercial power supply- inverter switch-over MC3		
20	120	BOF	Brake opening request	ppening request Refer to Pr. 278 to Pr. 285 (brake sequence functions).	
25	125	FAN	Fan fault output	Output when a fan fault occurs.	Pr. 244
26	126	FIN	Fin overheat pre-alarm	Output when the heat sink temperature reaches about 85% of the fin overheat protection temperature.	
27	127	ORA	In-position	When orientation is valid (only when FR-A5AP	
28	128	ORM	Orientation error	option is loaded)	
29	129	Y29	Overspeed detection	For PLG feedback control, vector control	
30	130	Y30	Forward running output	(only when the FR-A5AP option is loaded)	
31	131	Y31	Reverse running output		
32	132	Y32	Regeneration status output	For vector control	
33	133	RY2	Operation ready 2	(only when the FR-A5AP option is loaded)	
98	198	LF	Minor fault output	Output when a minor fault occurs.	
99	199	ABC	Alarm output	Output when the inverter's protective function is activated to stop the output (major fault).	
99	999		No function		

0 to 99: Positive logic 100 to 199: Negative logic

Note: 1. Under PLG feedback control (when the FR-A5AP option is loaded), the operations of the up-to-frequency SU and frequency detection FU, FU2, FU3 are as follows:

SU, FU: The actual speed (frequency) provided by the PLG feedback signal is output at or above the frequency specified for detection.

- FU, FU3: The inverter output frequency is output at or above the frequency specified for detection.
- 2. When the frequency setting is varied with the analog signal or the [UP/DOWN] key of the operation panel, note that the output of the SU (up-to-frequency) signal may alternate between ON and OFF due to that varying speed and the timing of the varying speed dependent on the acceleration/deceleration time setting.
 - (Such alternation will not take place when the acceleration/deceleration time setting is "0 seconds".)
- 3. This signal is output when "5" is set in Pr. 79 "operation mode selection" and the external operation mode is selected (the inverter goes into the programmed mode).
- 4. The same function may be set to more than one terminal.
- 5. When the function is activated, the terminal conducts with the settings of 0 to 99 and does not conduct with the settings of 100 to 199.
- 6. Pr. 190 to Pr. 195 do not function if the values set are other than the above.
- 7. When Pr. 76 = 1 or 3, the output signals of the SU, IPF, OL and FU output terminals conform to Pr. 76. When an inverter alarm occurs, the signal outputs are switched over to alarm code outputs.
- 8. The output assignment of the RUN terminal and alarm output relay conforms to the above setting independently of Pr. 76.

Pr. 199 "user's initial value setting"

Related parameter -

Pr. 77 "parameter write disable selection"

Among the parameters, you can set user-only parameter initial values. These values may be set to 16 parameters.

By performing user clear operation from the operation panel or parameter unit, you can initialize the parameters to the user-set initial values. Note that the parameters of which initial values have not been set are initialized to the factory settings by user clear operation.

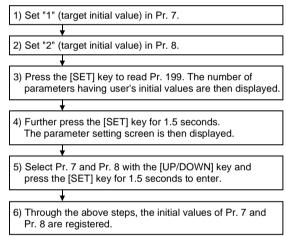
You can read the user's initial value list in the help mode of the parameter unit (FR-PU04).

Parameter Number	Factory Setting	Setting Range
199	0	0 to 999, 9999

The read Pr. 199 value is displayed as the number of parameters registered.

<Setting example>

(1) To set "1" in Pr. 7 and "2" in Pr. 8 as user's initial values. (Operation from the FR-DU04)



The settings of the parameters whose numbers are set in Pr. 199 (i.e. Pr. 7 = 1, Pr. 8 = 2 in the above example) are user's initial values.

(2) Deletion of user's initial values

By writing "9999" to Pr. 199 (and pressing the [SET] key for 1.5 seconds), the user's initial values registered are batch-deleted.

- Note: 1. When user's initial values for Pr. 902 to Pr. 905 are set, one parameter uses the area of two parameters for registration.
 - 2. As this setting is concerned with user-cleared initial values, the parameter numbers which cannot be cleared cannot be set.
 - 3. The operation panel (FR-DU04) cannot be used to refer to user's initial values.
 - 4. Values cannot be registered to Pr. 201 to Pr. 231.

PARAMETERS

Pr. 200 "program minute/second selection"

Pr. 201 to Pr. 210 "program setting 1 to 10"

Pr. 211 to Pr. 220 "program setting 11 to 20"

Pr. 221 to Pr. 230 "program setting 21 to 30"

Pr. 231 "time-of-day setting"

Related parameters

Pr. 76 "alarm code output selection"

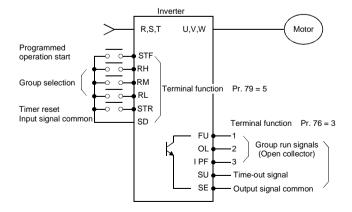
Pr. 79 "operation mode selection"

- In programmed operation, automatic operation is performed under the control of the internal timer in accordance with the preset time of day, running frequency and rotation direction.
- This function is made valid when the following parameter is set to the following value:
 - Pr. 79 = "5" (programmed operation)
- You can select the time unit for programmed operation between "minute/second" and "hour/minute".
- The start time of day, rotation direction and running frequency are defined as one point and every 10 points are grouped into three:
 - Group 1: Pr. 201 to Pr. 210
 - Group 2: Pr. 211 to Pr. 220
 - Group 3: Pr. 221 to Pr. 230
- Use Pr. 231 to set the time of day when programmed operation is started.

Parameter Number	Factory Setting	Setting Range	Remarks
200	0	0 to 3	0, 2 [minute/second] 1, 3 [hour/minute]
201 to 210	0,9999,0	0 to 2 0 to 400, 9999 0 to 99.59	0 to 2: Rotation direction 0 to 400, 9999: Frequency 0 to 99.59: Time
211 to 220	0,9999,0	0 to 2 0 to 400, 9999 0 to 99.59	0 to 2: Rotation direction 0 to 400, 9999: Frequency 0 to 99.59: Time
221 to 230	0,9999,0	0 to 2: Rotation direction 0 to 400, 9999: Frequency 0 to 99.59: Time	0 to 2: Rotation direction 0 to 400, 9999: Frequency 0 to 99.59: Time
231	0	0 to 99.59	

<Wiring example>

For sink logic



<Setting>

(1) Set the time unit for programmed operation in Pr. 200. Select either of "minute/second" and "hour/minute".

Setting	Description		
0	Minute/second unit (voltage monitor)		
1	Hour/minute unit (voltage monitor)		
2	Minute/second unit (reference time of day monitor)		
3	Hour/minute unit (reference time of day monitor)		

- Note: 1. When "2" or "3" is set in Pr. 200, the reference time-of-day monitor screen is displayed instead of the voltage monitor screen.
 - 2. Note that when the Pr. 200 setting is changed, the units for Pr. 201 to Pr. 231 setting will change.
- (2) The inverter has an internal timer (RAM). When the reference time of day is set in Pr. 231, programmed operation is started at this time of day.
 - 1) Setting range

The time unit depends on the Pr. 200 setting.

Pr. 200 Setting	Pr. 231 Setting Range	Pr. 200 Setting	Pr. 231 Setting Range
0	Maximum 99 minutes 59 seconds	2	Maximum 99 minutes 59 seconds
1	Maximum 99 hours 59 minutes	3	Maximum 99 hours 59 minutes

Note: The reference time-of-day timer returns to "0" when both the start signal and group select signal are entered. Set the reference time of day in Pr. 231 when both signals are on.

2) Resetting the reference time of day

The reference time of day is cleared by switching on the timer reset signal (STR) or by resetting the inverter. Note that the reference time-of-day value set in Pr. 231 is also reset to "0".

(3) Program setting

The rotation direction, running frequency and start time of day can be set by using Pr. 201 to Pr. 231.

	Setting Point	Rotation Direction, Frequency, Start Time of Day
	No.1	Pr. 201
	2	Pr. 202
	3	Pr. 203
Group 1	4	Pr. 204
	•	•
	•	•
		P. 040
	10	Pr. 210
	No.11	Pr. 211
Group 2	•	•
	•	•
		-
	20	Pr. 220
	No.21	Pr. 221
Group 3		•
	•	•
	•	
	30	Pr. 230
	•	

Parameter Number	Name	Setting Range	Factory Setting	Remarks
201 to 230	Programmed operation minute/second selection	0 to 2	0	Rotation direction setting 0: Stop, 1: Forward rotation, 2: Reverse rotation
		0 to 400Hz	9999	Frequency setting
		0 to 99:59	0	Time of day setting

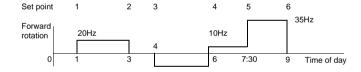
<Setting procedure>

(Example: Set point No. 1, forward rotation, 30Hz, 4 hours 30 minutes)

- 1) Read Pr. 201 value.
- 2) Enter "1" (forward rotation) in Pr. 201 and press the [SET] key ([WRITE] key when using the FR-PU04 parameter unit).
- 3) Enter 30 (30Hz) and press the [SET] key ([WRITE] key when using the FR-PU04 parameter unit). (Note 1)
- 4) Enter "4.30" and press the [SET] key ([WRITE] key when using the FR-PU04 parameter unit). (Note 2)
- 5) Press the [UP] key to move to the next parameter (Pr. 202), and press the [SET] key ([READ] key when using the FR-PU04 parameter unit) to display the current setting. Hereafter, press the [UP] key to advance the parameter one by one.
 - Note 1: To make a stop, write "0" in the rotation direction and frequency. Set "9999" for no setting.
 - Note 2: An error will result if 4.80 is entered (59 minutes or 59 seconds is exceeded).
 - Assuming that operation has been programmed as indicated in the following table, the operation pattern is as shown in the figure below:

No.	Operation	Parameter Setting
1	Forward rotation, 20Hz, 1 hour 0 minutes	Pr. 201 = 1, 20, 1:00
2	Stop, 3 hours 0 minutes	Pr. 202 = 0, 0, 3:00
3	Reverse rotation, 30Hz, 4 hours 0 minutes	Pr. 203 = 2, 30, 4:00
4	Forward rotation, 10Hz, 6 hours 0 minutes	Pr. 204 = 1, 10, 6:00
5	Forward rotation, 35Hz, 7 hours 30 minutes	Pr. 205 = 1, 35, 7:30
6	Stop, 9 hours 0 minutes	Pr. 206 = 0, 0, 9:00

<Operation pattern>



(4) Input signals

Name	Description	Signal Level	Remarks
Group signal			
RH (group 1)	Used to select the group for		
RM (group 2)	programmed operation.	Photocoupler isolated	May also be driven by transistor. When ic = 10mA,
RL (group 3)			
Timer reset signal (STR)	Input to zero the reference time of day.	Isolated	Vec<0.5V should be satisfied.
Programmed operation start	Input to start programmed operation.		
signal (STF)	Imput to start programmed operation.		

(5) Output signals

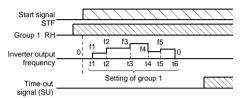
Name	Description	Signal Level	Remarks
Time-out signal (SU)	Output on completion of the operation of the selected group and cleared on timer reset.	Open collector	Permissible load
Group select signals (FU, OL, IPF)	Output during running of corresponding group's program and cleared on timer reset.	output (isolated)	24VDC, 0.1A Only when Pr. 76 = 3

(6) Operation

1) Ordinary operation

After completion of all preparations and settings, turn on the desired group select signal (any of RH (group 1), RM (group 2) and RL (group 3)), then turn on the start signal (STF). This causes the internal timer (reference time of day) to be reset automatically and the operation of that group to be performed in sequence in accordance with the settings. When the operation of the group ends, a signal is output from the time-out output terminal. (The open collector signal of SU is turned on.)

Note: Use the programmed operation function with "5" set in Pr. 79. Programmed operation will not be performed if any of the group select signals is switched on during PU operation or data link operation.

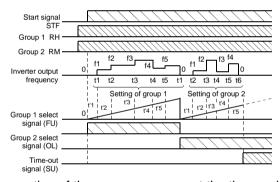


Note that the operation is not started if the timer reset signal (STR) is on.

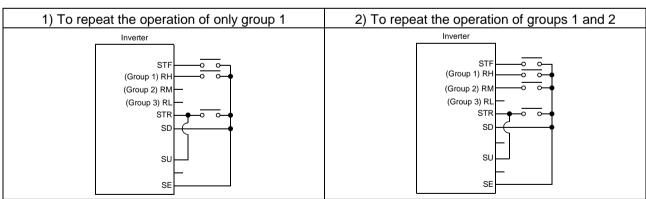
2) Multi-group select operation

When two or more groups are selected at the same time, the operations of the selected groups are executed in sequence of group 1, group 2 and group 3.

For example, if group 1 and group 2 have been selected, the operation of group 1 is first carried out, and after that operation ends, the reference time of day is reset, the operation of group 2 is started, and the time-out signal (SU) is output after the operation of group 2 ends.



(7) To repeat the operation of the same group, reset the timer using the time-out signal as shown below.



Note: 1. If the inverter power is switched off, then on (including an instantaneous power failure) during the execution of the programmed operation, the internal timer is reset and the inverter does not restart if the power is restored.

To resume the operation, turn the programmed operation start signal (STF) off, then on. (At this time, when it is required to set the reference time of day, switch the start signal on before setting.)

- 2. When the inverter is wired for programmed operation specifications, the following signals are invalid:AU, STOP, 2, 4, 1, JOG
- 3. During programmed operation, the inverter cannot be operated in any other mode. When the programmed operation start signal (STF) and timer reset signal (STR) are ON, the operation mode cannot be switched between PU operation and external operation.

Pr. 232 to Pr. 239 → Refer to Pr. 4.

Pr. 240 → Refer to Pr. 72.

Pr. 244 "cooling fan operation selection"

You can control the operation of the cooling fan built in the inverter (Whether there is a cooling fan or not depends on the model. Refer to the specifications (page 193).)

Parameter Number	Factory Setting	Setting Range
244	0	0, 1

<Setting>

Setting	Description		
0	Operated at power on (independently of whether the inverter is running or at a stop).		
1	Cooling fan on-off control valid (The cooling fan is always on while the inverter is running. During a stop, the inverter status is monitored and the fan switches on-off according to temperature.)		

<Reference>

In either of the following cases, fan operation is regarded as faulty, [FN] is shown on the operation panel, and the fan fault (FAN) and light fault (LF) signals are output. Use Pr. 190 to Pr. 195 (multi-function outputs) to allocate the terminals used to output the FAN and LF signals.

1) Pr. 244 = "0"

When the fan comes to a stop with power on.

2) Pr. 244 = "1"

When the fan stops during the fan ON command while the inverter is running, or when the fan starts during the fan OFF command.

Note: When the terminal functions are changed using Pr. 190 to Pr. 195, the other functions may be affected. Confirm the functions of the corresponding terminals before making setting.

Pr. 250 "stop selection"

Related parameter

Pr. 7 "acceleration time"

Pr. 8 "deceleration time"

Pr. 44 "second acceleration/deceleration time"

Pr. 45 "second deceleration time"

Pr. 110 "third acceleration/deceleration time"

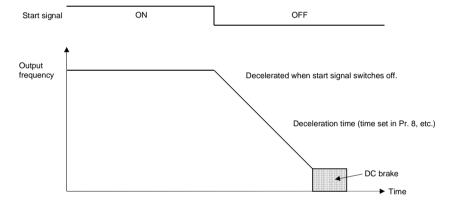
Pr. 111 "third deceleration time"

Used to select the stopping method (deceleration to a stop or coasting) when the start signal (STF/STR) switches off.

Parameter Number	Factory Setting	Setting Range
250	9999	0 to 100 s, 9999

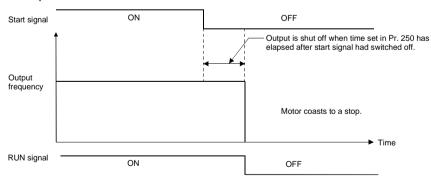
(1) Pr. 250 = "9999"

When the start signal switches off, the motor is decelerated to a stop.



(2) Pr. 250 = other than "9999"

The output is shut off when the time set in Pr. 250 has elapsed after the start signal had switched off. The motor coasts to a stop.



Note: 1. The RUN signal switches off when the output stops.

2. When the start signal is switched on again during motor coasting, the motor starts at 0Hz.

Pr. 251 "Output phase failure protection selection"

You can make invalid the output phase failure protection (E.LF) function which stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) becomes open.

Parameter Number	Setting Range	Minimum Setting Increments	Factory Setting	Description
251	0, 1	1	1	Without output phase failure protection With output phase failure protection

Pr. 252 "override bias"

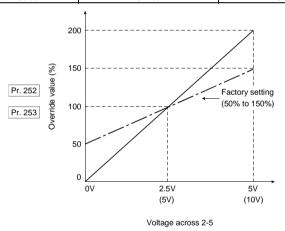
Pr. 253 "override gain"

Related parameters

Pr. 73 "0 to 5V, 0 to 10V selection"

You can extend the 50% to 150% override range (to 0% to 200%), which is covered when Pr. 73 "0 to 5V, 0 to 10V selection" is used to select the override, and set the override value as desired.

Parameter Number Setting Range		Minimum Setting Increments	Factory Setting
252 0 to 200%		0.1%	50%
253	253 0 to 200%		150%



Pr. 261 "power failure stop selection"

Pr. 262 "subtracted frequency at deceleration start"

Pr. 263 "subtraction starting frequency"

Pr. 264 "power-failure deceleration time 1"

Pr. 265 "power-failure deceleration time 2"

Related parameters -

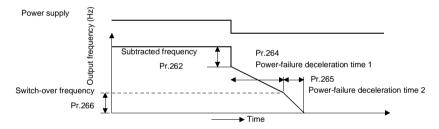
Pr. 12 "DC dynamic brake voltage" Pr. 20 "acceleration/deceleration reference frequency"

Pr. 266 "power-failure deceleration time switch-over frequency"

When an instantaneous power failure or undervoltage occurs, the inverter can be decelerated to a stop.

 Remove the jumpers across terminals R-R1 and terminals S-S1, and connect terminal R1 to terminal P, and terminal S1 to terminal N.

Parameter Number	Factory Setting	Setting Range
261	0	0, 1
262	3Hz	0 to 20Hz
263	60Hz	0 to 120Hz, 9999
264	5 s	0 to 3600/0 to 360 s
265	9999	0 to 3600/0 to 360 s, 9999
266	60Hz	0 to 400Hz



<Setting>

Parameter Setting		Setting	Description	
	261	0	Coasting to stop When undervoltage or power failure occurs, the inverter output is shut off.	
		1	When undervoltage or power failure occurs, the inverter is decelerated to a stop.	
262		0 to 20Hz	Normally, operation can be performed with the factory setting unchanged. The frequency can be adjusted within the range 0 to 20Hz according to the load specifications (inertia moment, torque).	
	263	0 to 120Hz	If the output frequency at occurrence of undervoltage or power failure is equal to or greater than the frequency set in Pr. 263, deceleration starts at the value found by subtracting the frequency set in Pr. 262 from the output frequency at that time. If the output frequency at occurrence of undervoltage or power failure is less than the frequency set in Pr. 263, the inverter is decelerated to a stop, starting at the output frequency at that time.	
		9999	The inverter is decelerated to a stop, starting at the value found by subtracting the frequency set in Pr. 262 from the output frequency at occurrence of undervoltage or power failure.	
264	Pr. 21 = 0	0 to 3600 s	Set a deceleration slope down to the frequency set in Pr. 266. Set the slope in terms of time	
264	Pr. 21 = 1 0 to 360 s		required for deceleration from the frequency set in Pr. 20 to 0Hz.	
	Pr. 21 = 0 0 to 3600 s		Set a deceleration slope below the frequency set in Pr. 266. Set the slope in terms of time	
265	265 Pr. 21 = 1 0 to 3		required for deceleration from the frequency set in Pr. 20 to 0Hz.	
		9999	Same slope as in Pr. 264	
	266	0 to 400Hz	Set the frequency at which the deceleration slope is is switched from the Pr. 264 setting to the Pr. 265 setting.	

PARAMETERS

- Note: 1. This function is invalid when the automatic restart after instantaneous power failure function is activated.
 - 2. If (output frequency at occurrence of undervoltage or power failure) minus (frequency set in Pr. 263) is negative, the calculation result is regarded as 0Hz.
 - 3. The power failure stop function is not activated during a stop or error.
 - 4. If power is restored during deceleration, the inverter is kept decelerating to a stop. To restart, switch off the start signal once, then switch it on again.
 - 5. When the high power factor converter is used (Pr. 30 = 2), this function is made invalid.

! CAUTION

⚠ If power-failure deceleration operation is set, some loads may cause the inverter to trip and the motor to coast.

If enough regenerative energy is not given by the motor, the motor will coast.

Pr. 270 "stop-on-contact, load torque high-speed frequency selection"

Related parameters

Pr. 271 "high-speed setting maximum current"

Pr. 272 "mid-speed setting minimum current"

Pr. 273 "current averaging range"

Pr. 274 "current averaging filter constant"

Pr. 275 "stop-on-contact exciting current low-speed multiplying factor"

Pr. 276 "stop-on-contact PWM carrier frequency"

To ensure accurate positioning at the upper limit etc of a lift, stop-on-contact control causes a mechanical brake to be closed while the motor is developing a holding torque to keep the load in contact with a mechanical stopper etc.

This function suppresses vibration which is liable to occur when the load is stopped upon contact in vertical motion applications, ensuring steady precise positioning.

Load torque high-speed frequency control automatically sets the maximum operating frequency according to the load.

Specifically, the weight of the load is determined after a start by the average current at a given time; when the load is light, the preset frequency can be increased for operation.

When the load is light, speed can be automatically increased in a sky parking lot, for example, to reduce incoming and outgoing times.

- Using Pr. 270, select stop-on-contact control and/or high-speed frequency control (control which automatically switches between high- and middle-speed operations according to load torque).
 - When stop-on-contact control is selected, select advanced magnetic flux vector control. For function details, refer to Pr. 275 and Pr. 276.
 - For function details of load torque high-speed frequency control, refer to Pr. 271 to Pr. 274.

Parameter Number	Factory Setting	Setting Range	Description	
		0	Without stop-on-contact control and load torque high-speed frequency control	
270	0	0	1	Stop-on-contact control
270		2	Load torque high-speed frequency control	
		3	Stop-on-contact control and load torque high-speed frequency control	

Pr. 271 "high-speed setting maximum current"

Pr. 272 "mid-speed setting minimum current"

Pr. 273 "current averaging range"

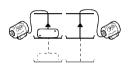
Pr. 274 "current averaging filter constant"

Related parameters

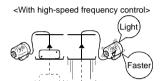
- Pr. 4 "multi-seed setting (high speed)"
- Pr. 5 "multi-seed setting (middle speed)"
- Pr. 6 "multi-seed setting (low speed)"
- Pr. 59 "remote setting function selection"
- Pr. 180 to Pr. 186
 - (input terminal function selection)
- Pr. 270 "stop-on-contact, load torque high-speed frequency selection"
- Used to set the current, averaging range, etc. required when "2" or "3" is set in Pr. 270 to select load torque high-speed frequency control.

Parameter Number	Factory Setting	Setting Range
271	50%	0 to 200%
272	100%	0 to 200%
273	9999	0 to 400Hz, 9999
274	16	1 to 4000

<Without high-speed frequency control>



Whether there is a load or not, the lift is moved vertically at the same speed.

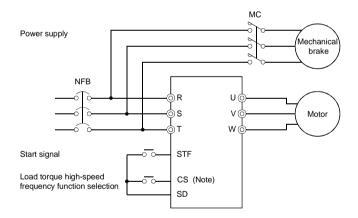


The lift with a light load or without a load is moved faster than the lift with a load.

(The output frequency is increased.)

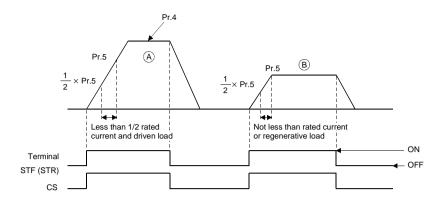
<Wiring example>

- Sink logic
- Pr. 186 = 19

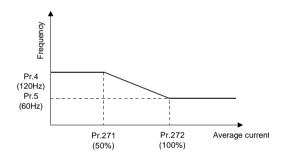


Note: The input signal terminal used depends on the Pr. 180 to Pr. 186 settings.

<Operation example>



- When operation is performed with X19 (load detection high-speed frequency function selection) signal on, the inverter automatically varies the maximum frequency between Pr. 4 "multi-speed setting (high speed)" and Pr. 5 "multi-speed setting (middle speed)" settings as shown below according to the average current flowing during acceleration from the frequency half of the Pr. 5 setting to the frequency set in Pr. 5.
- Example: 1. If the average current is not more than half of the rated inverter current, the maximum frequency is the value set in Pr. 4 as shown in operation example (A).
 - 2. If the average current is not less than the rated inverter current, the maximum frequency is the value set in Pr. 5 as shown in operation example (B).



<In this example, the frequency varies according to the current; 60Hz for 100% current and 120Hz for 50% current.>

<Setting>

- 1) Set "2 or 3" in Pr. 270.
- 2) Assign X19 (load detection high-speed frequency function selection) to the input terminal using any of Pr. 180 to Pr. 186.
- 3) Refer to the following table and set the parameters:

Parameter Number	Name	Setting	Description	
4	Multi-speed setting (high speed)	0 to 400Hz	Set the higher-speed frequency.	
5	Multi-speed setting (middle speed)	0 to 400Hz	Set the lower-speed frequency.	
271	High-speed setting maximum current	0 to 200%	Set the upper and lower limits of the current at high and middle	
272	Mid-speed setting minimum current	0 to 200%	speeds.	
273	Current overaging ronge	0 to 400Hz	(Average current during acceleration from (Pr. $273 \times 1/2$) Hz to (Pr. 273) Hz can be achieved.	
213	Current averaging range	9999	Average current during acceleration from (Pr. $5 \times 1/2$) Hz to (Pr. 5) Hz is achieved.	
274	Current averaging filter constant	1 to 4000	Set the time constant of the primary delay filter relative to the output current. (The time constant [ms] is 0.75 × Pr. 274 and the factory setting is 12ms.) A larger setting provides higher stability but poorer response.	

- Note: 1. This function is only valid in the external operation mode. This function is not activated when "1" or "2" (remote setting function) is selected for Pr. 59.
 - 2. If the current averaging zone includes the low output region, the output current may increase in the constant-output region. When the current is low, the running frequency increases, increasing the deceleration time.
 - 3. The maximum output frequency is 120Hz. If its setting exceeds 120Hz, the output frequency is 120Hz.
 - 4. The fast-response current limit function is invalid.
 - 5. Can be activated at every start.
 - 6. When the terminal functions are changed using Pr. 180 to Pr. 186, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

!CAUTION

- ⚠ When the load is light, the motor may accelerate suddenly up to 120Hz, causing hazardous conditions. Provide sufficient interlocks on the machine side before starting operation.
- Set frequency reference table for load torque high-speed frequency control
 The following table lists the frequencies set when the load torque high-speed frequency control signal (X19) and multi-speed terminals (RH, RM, RL) are selected together:

	Input	Signals		Set Frequency		
X19	RH	RM	RL	Set Frequency		
0				Conforms to load torque h	nigh-speed frequency control.	
	0			Speed 1 (high speed)	Pr. 4	
		0		Speed 2 (middle speed)	Pr. 5	
			0	Speed 3 (low speed)	Pr. 6	
0	0			Speed 1 (high speed)	Pr. 4	
0		0		Speed 2 (middle speed)	Pr. 5	
0			0	Speed 3 (low speed)	Pr. 6	
	0	0		Speed 6	Pr. 26	
	0		0	Speed 5	Pr. 25	
		0	0	Speed 4	Pr. 24	
0	0	0		Speed 6	Pr. 26	
0		0	0	Speed 4	Pr. 24	
	0	0	0	Speed 7	Pr. 27	
0	0		0	Speed 5	Pr. 25	
0	0	0	0	Speed 7	Pr. 27	
			, in the second	Setting using terminal 2, 1, 4, JOG		

O indicates that the signal is on.

- Note: 1. Assumes that the external operation command mode is selected and the remote setting function is not selected.
 - 2. Multi-speeds override the main speeds (across terminals 2-5, 4-5, 1-5).
 - 3. When the 12-bit digital speed input (option FR-A5AX) is selected, the above list is invalid. (The 12-bit digital speed input has the highest priority.)
 - 4. Jog operation overrides the above list.

• Function list (The following specifications apply to the external operation mode.)

Pr. 270 Setting	Load Torque High-Speed Frequency Control	Stop-On-Contact Control	Multi-Speeds (7 speeds)
0	×	×	0
1	×	0	0
2	0	×	0
3	0	0	0

O: Indicates that the function is valid.

- Restrictions when 1 to 3 are selected for Pr. 270
 - Under the following conditions, the functions of Pr. 270 settings "1 to 3" are made invalid:
 - PU operation
 - Programmed operation
 - PU + external combined
 - PID control
 - Remote setting function mode
 - Orientation control (option FR-A5AP)
 - Jog operation (common to PU and external operations)

Pr. 275 "stop-on-contact exciting current low-speed multiplying factor"

Pr. 276 "stop-on-contact PWM carrier frequency"

Related parameters

Pr. 4 "multi-seed setting (high speed)"

Pr. 5 "multi-seed setting (middle speed)"

Pr. 6 "multi-seed setting (low speed)"

Pr. 48 "second stall prevention operation current"

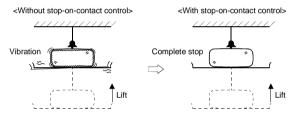
Pr. 72 "PWM carrier frequency"

Pr. 180 to Pr. 186 (input terminal function selection)

Pr. 270 "stop-on-contact, load torque high-speed frequency selection"

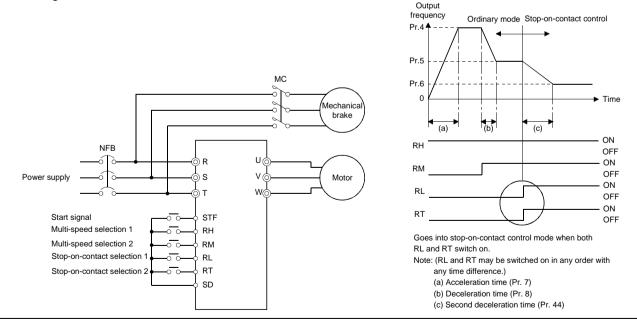
• Set "1 or 3" (stop-on-contact control) in Pr. 270. Also advanced magnetic flux vector control must be selected.

Parameter Number	Factory Setting	Setting Range
270	0	0, 1, 2, 3,
275	9999	0 to 1000%, 9999
276	9999	0 to 15, 9999



<Wiring and operation examples>

Sink logic



Note: The input signal terminals used depend on the Pr. 180 to Pr. 186 settings.

When both the RT and RL terminals are switched on, the inverter enters the stop-on-contact mode, in which operation is performed at the frequency set in Pr. 6 "multi-speed setting (low speed)" independently of the preceding speed.

- Note: 1. By increasing the Pr. 275 setting, the low-speed (stop-on-contact) torque increases, but the overcurrent alarm (E.OCT) may occur or the machine may oscillate in a stop-on-contact state.
 - 2. The stop-on-contact function is different from the servo lock function, and if used to stop or hold a load for an extended period, the function can cause the motor to overheat. After a stop, immediately reset this function and use a mechanical brake to hold the load.
 - 3. Under the following operating conditions, the stop-on-contact function is made invalid:
 - PU operation
 - Programmed operation
 - PU + external operation
 - PID control function operation
 - Remote setting function operation
 - Orientation control function operation
 - Jog operation

<Setting>

- 1) Select advanced magnetic flux vector control and set "1" or "3" in Pr. 270.
- 2) Refer to the following list and set the parameters:

Parameter Number	Name	Setting	Description
6	Multi-speed setting (low speed)	0 to 400Hz	Set the output frequency for stop-on-contact control. The frequency should be as low as possible (about 2Hz). If it is set to more than 30Hz, the operating frequency will be 30Hz. When stop-on-contact control is to be exercised during PLG feedback control, PLG feedback control is made invalid when the inverter enters the stop-on-contact control mode.
48	Second stall prevention operation current	0 to 200%	Set the stall prevention operation for stop-on-contact control.
275	Stop-on-contact exciting current low-speed multiplying factor	0 to 1000% 9999	Usually set a value between 130% and 180%. Set the force (holding torque) for stop-on-contact control. No compensation
276	Stop-on-contact PWM	0 to 15	Set a PWM carrier frequency for stop-on-contact control. (Valid at the frequency of 3Hz or less)
	carrier frequency	9999	Conforms to the Pr. 72 "PWM carrier frequency selection".

Function switch-over when stop-on-contact control is selected

Operation Mode (External)	Ordinary Operation		Stop-on-Cor	ntact Control		
RL, RT terminals	RL	RT	RL	RT	Remarks	
Main function	Either	is OFF	ON	ON		
Output frequency for a stop on contact	Multi-speeds 0 to 5V, 0 to 4 to 20mA		Pr. 6 "low-speed frequency"			
Stall prevention operation level	Pr. 22 (stall properation levers		Pr. 48 (second stall prevention operation current)		When RL and RT are on, Pr. 49 (second stall prevention operation frequency) is invalid.	
Exciting current low-speed multiplying factor			The current is compensated for by the multiplying factor (0 to 1000%) set in Pr. 275 before RL and RT are switched on.			
Carrier frequency	Pr. 72 "PWI select (0 to	. ,	Pr. 276 (stop-on-contact PWM carrier frequency) (0 to 15, 9999)			
Fast-response current limit	Ye	es	N	lo		

PARAMETERS

Frequencies set in stop-on-contact control (Pr. 270 = 1 or 3) (In external operation mode) The following table lists the frequencies set when the input terminals (RH, RM, RL, RT, JOG) are selected together.

	Inp	ut Sign	als				Stop-on-	
RH	RM	RL	RT	JOG	Set Frequency		Contact Control Function	Remarks
0					Speed 1 (high speed)	Pr. 4		
	0				Speed 2 (middle speed)	Pr. 5		
		0			Speed 3 (low speed)	Pr. 6		
			0		According to 0-5V, 0-10V, 4-2	0mA		
				0	Jog frequency	Pr. 15		
0	0				Speed 6	Pr. 26		Middle speed when Pr. 26 = 9999
0		0			Speed 5	Pr. 25		Low speed when Pr. 25 = 9999
0			0		Speed 1 (high speed)	Pr. 4		
0				0	Jog frequency	Pr. 15		
	0	0			Speed 4	Pr. 24		Low speed when Pr. 24 = 9999
	0		0		Speed 2 (middle speed)	Pr. 5		
	0			0	Jog frequency	Pr. 15		
		0	0		Speed 3 (low speed, stop-on-o	contact	•	
		0			frequency)	Pr. 6	•	
		0		0	Jog frequency	Pr. 15		
			0	0	Jog frequency	Pr. 15		
		0	0	0	Jog frequency	Pr. 15		
	0		0	0	Jog frequency	Pr. 15		
	0	0		0	Jog frequency	Pr. 15		
	0	0	0		Speed 3 (low speed, stop-on-ofrequency)	contact Pr. 6	•	
0			0	0	Jog frequency	Pr. 15		
0		0		0	Jog frequency	Pr. 15		
0		0	0		Speed 3 (low speed, stop-on-ofrequency)	contact Pr. 6	•	
0	0			0	Jog frequency	Pr. 15		
0	0		0		Speed 6	Pr. 26		Middle speed when Pr. 26 = 9999
0	0	0			Speed 7	Pr. 27		Low speed when Pr. 27 = 9999
	0	0	0	0	Jog frequency	Pr. 15		
0		0	0	0	Jog frequency	Pr. 15		
0	0		0	0	Jog frequency	Pr. 15		
0	0	0		0	Jog frequency	Pr. 6		
0	0	0	0		Speed 3 (low speed, stop-on-contact frequency) Pr. 6		•	
0	0	0	0	0	Jog frequency	Pr. 15		
					According to 0-5V, 0-10V, 4-2	0mA		

^{*} o indicates that the function is selected.

Note: 1. O indicates that the signal is on.

- 2. Indicates that the remote setting function is not selected. (The remote setting function disables stop-on-contact control.)
- The selection of the 12-bit digital speed input FR-A5AX (option) makes the above list invalid.
 Note that when both RL and RT are on, the frequency is as set in Pr. 6 and stop-on-contact
 control is exercised.
- 4. The jog frequency has the highest priority.
- 5. When the terminal functions are changed using Pr. 180 to Pr. 186, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

Pr. 278 "brake opening frequency"

Pr. 279 "brake opening current"

Pr. 280 "brake opening current detection time"

Pr. 281 "brake operation time at start"

Pr. 282 "brake operation frequency"

Pr. 283 "brake operation time at stop"

Pr. 284 "deceleration detection function selection"

Pr. 285 "overspeed detection frequency"

Related parameters-

Pr. 60 "intelligent mode selection"

Pr. 80 "motor capacity"

Pr. 81 "number of motor poles"

Pr. 180 to Pr. 186 (input terminal

function selection) Pr. 190 to Pr. 195

(output terminal function selection)

This function is used to output from the inverter the mechanical brake opening completion signal timing signal in vertical lift and other applications.

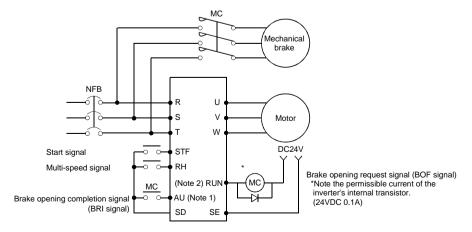
This function prevents the load from dropping with gravity at starting due to the operation timing fault of the mechanical brake or an overcurrent alarm from occurring at a stop, ensuring secure operation.

- The mechanical brake opening completion signal may either be entered or not entered into the inverter.
- This function is only valid when "7" or "8" is set in Pr. 60 to select brake sequence mode. (With the exception of Pr. 285)

Parameter Number	Factory Setting	Setting Range
278	3Hz	0 to 30Hz
279	130%	0 to 200%
280	0.3 sec	0 to 2 sec
281	0.3 sec	0 to 5 sec
282	6Hz	0 to 30Hz
283	0.3 sec	0 to 5 sec
284	0	0, 1
285	9999	0 to 30Hz, 9999

<Wiring example>

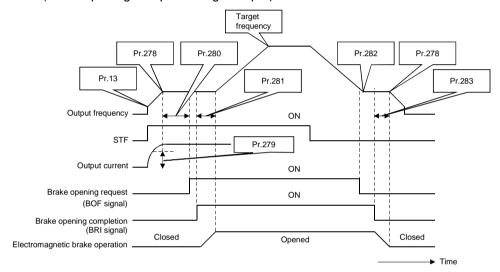
- Sink logic
- Pr. 184 = 15
- Pr. 190 = 20



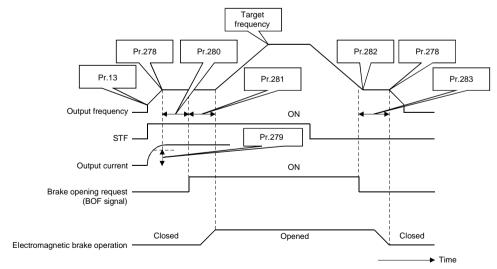
- Note: 1. The input signal terminal used depends on the Pr. 180 to Pr. 186 settings.
 - 2. The output signal terminal used depends on the Pr. 190 to Pr. 195 settings.

<Operation example>

- At start: When the start signal is input to the inverter, the inverter starts running. When the output frequency reaches the value set in Pr. 278 and the output current is not less than the value set in Pr. 279, the inverter outputs the brake opening request signal (BOF) after the time set in Pr. 280 has elapsed. When the time set in Pr. 281 elapses after the brake opening completion signal (BRI) was activated, the inverter increases the output frequency to the set speed.
- At stop: When the speed has decreased to the frequency set in Pr. 282, the brake opening request signal (BOF) is switched off. When the time set in Pr. 283 elapses after the brake operation confirmation signal (BRI) was activated, the inverter output is switched off.
 - * If Pr. 60 = "8" (mechanical brake opening completion signal not input), this time is the time after the brake opening request signal is output.
 - 1) Pr. 60 = "7" (brake opening completion signal input)



2) Pr. 60 = "8" (mechanical brake opening completion signal not input)



<Setting>

(1) Parameter setting

- 1) Select advanced magnetic flux vector control. (Pr. 80, Pr. 81 ≠"9999")
- 2) Set "7 or 8" (brake sequence mode) in Pr. 60. To ensure more complete sequence control, it is recommended to set "7" (brake opening completion signal input) in Pr. 60. Note that the automatic restart after instantaneous power failure function is not activated when the brake sequence mode is selected.
- 3) Refer to the following table and set the parameters:

Parameter Number	Name	Setting	Description
278	Brake opening frequency	0 to 30Hz	Set to the rated slip frequency of the motor + about 1.0Hz. This parameter may only be set if Pr. 278 ≤ Pr. 282.
279	Brake opening current	0 to 200%	Generally, set this parameter to about 50 to 90%. If the setting is too low, the load is liable to drop with gravity at start. Suppose that the rated inverter current is 100%.
280	Brake opening current detection time	0 to 2 sec	Generally, set this parameter to about 0.1 to 0.3 seconds.
281	Brake operation time at start	0 to 5 sec	Pr. 60 = 7: Set the mechanical delay time until the brake is loosened. Pr. 60 = 8: Set the mechanical delay time until the brake is loosened + about 0.1-0.2 seconds.
282	Brake closing frequency	0 to 30Hz	At this frequency, the brake opening request signal (BOF) is switched off. Generally, set this parameter to the Pr. 278 setting + 3-4Hz. This parameter may only be set if Pr. 282 ≥ Pr. 278.
283	Brake operation time at stop	0 to 5 sec	Pr. 60 = 7: Set the mechanical delay time until the brake is closed + 0.1 seconds. Pr. 60 = 8: Set the mechanical delay time until the brake is closed + about 0.2 to 0.3 seconds.
	Deceleration	0	Deceleration is not detected.
284 detection function selection		1	If deceleration is not normal during deceleration operation, the inverter alarm (E.MB2) is provided to shut off the output and switch off the brake opening request signal (BOF).
285	Overspeed detection frequency	0 to 30Hz	If (detected frequency) - (output frequency) > Pr. 285 in the PLG feedback control mode, the inverter alarm (E.MB1) is provided to shut off the output and switch off the brake opening request signal (BOF).
		9999	Overspeed is not detected.

Note: When using this function, set the acceleration time to 1 second or longer.

(2) Explanations of terminals used

The terminals must be allocated using Pr. 180 to Pr. 186 and Pr. 190 to Pr. 195.

		Brake Sequence Mode		
Signal	Terminals Used	Pr. 60 = 7 (with mechanical brake opening completion signal)	Pr. 60 = 8 (without mechanical brake opening completion signal)	
BOF	According to Pr. 190 to Pr. 195	Brake opening request	Brake opening request	
BRI	According to Pr. 180 to Pr. 186	Brake opening completion signal		

Note: 1. The brake opening completion signal (BRI) is a parameter valid when Pr. 60 = 7.

2. When the terminal functions are changed using Pr. 180 to 186 and Pr. 190 to Pr. 195, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

PARAMETERS

(3) Protective functions

If any of the following errors occur in the brake sequence mode, the inverter results in an alarm, shuts off the output and switches off the brake opening request signal (BOF terminal).

On the operation panel (FR-DU04) LED and parameter unit (FR-PU04) screen, the following errors are displayed:

Error Display	Error Display
E.MB1	(Detected frequency) - (output frequency) > Pr. 286 in the PLG feedback control mode. (Overspeed detection function)
E.MB2	Deceleration is not normal during deceleration operation (Use Pr. 284 to select this function.) (Except stall prevention operation)
E.MB3	Brake opening request signal (BOF) switched on though the motor is at a stop. (Gravity drop prevention function)
E.MB4	More than 2 seconds after the run command (forward or reverse rotation) is input, the brake opening request signal (BOF) does not switch on.
E.MB5	More than 2 seconds after the brake opening request signal switched on, the brake opening completion signal (BRI) does not switch on.
E.MB6	Though the inverter had switched on the brake opening request signal (BOF), the brake opening completion signal (BRI) switched off during that period.
E.MB7	More than 2 seconds after the brake opening request signal (BOF) switched off at a stop, the brake opening completion signal (BRI) does not switch off.

Note: During PLG feedback control (when the FR-A5AP option is loaded), overspeed detection (Pr. 285) is valid if the Pr. 60 setting is other than "7 or 8".

4

Pr. 286 "Droop gain"

Pr. 287 "Droop filter time constant"

Related parameters

Pr. 9 "electronic overcurrent protection"

Pr. 71 "applied motor"

Pr. 84 "rated motor frequency"

This function balances the load in proportion to the load torque with or without PLG, and provides speed drooping characteristics.

This is effective in balancing the load when using multiple inverters.

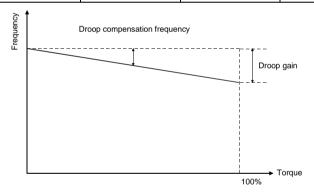
 The output frequency is varied according to the amount of torque current during unbalanced flux vector control and vector control.

The drooping amount at the rated torque is set by the droop gain as a percentage using the rated frequency as a reference.

Droop compensation frequency = $\frac{\text{Amount of torque current after filtering}}{\text{Rated current}} \times \frac{\text{Rated frequency} \times \text{droop gain}}{100}$

- Confirm the following items when using the droop control.
 - 1. This function is valid when Pr. 286 ≠ "0" during unbalanced flux vector and vector control.
 - 2. This function is valid when the operation state is constant speed operation.
 - 3. The upper limit of the droop compensation frequency is 120Hz.
 - 4. The rated current follows the value set in Pr. 9 "Motor rated current".

Parameter No.	Name	Setting range	Min. setting unit	Factory setting
286	Droop gain	0 to 100%	0.01%	0%
287	Droop filter time constant	0.00 to 1.00s	0.01s	0.3s



<Setting>

Refer to the following table and set each parameter.

Parameter No.	Details
286	Set the drooping amount at the rated torque as a percentage with respect to the rated frequency.
	When the setting value is "0", the function will be invalid (no droop control).
287	Set the time constant of the filter applied on the torque amount current.

PARAMETERS

Pr. 900 "FM terminal calibration"

Pr. 901 "AM terminal calibration"

Related parameters

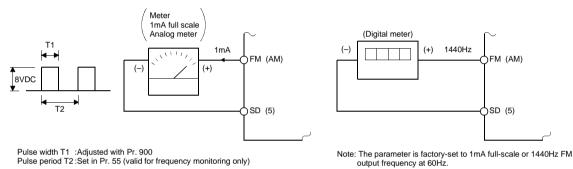
Pr. 54 "FM terminal function selection"

Pr. 55 "frequency monitoring

reference"

Pr. 56 "current monitoring reference"

- By using the operation panel/parameter unit, you can calibrate a meter connected to terminal FM to full
- Terminal FM provides the pulse output. By setting Pr. 900, you can calibrate the meter connected to the inverter from the parameter unit without providing a calibration resistor.
- You can display a digital value on a digital counter using the pulse train signal from terminal FM. A 1440Hz output is provided at the full scale value as explained in the section of Pr. 54. When the running frequency has been selected for monitoring, the ratio of this FM terminal output frequency can be set in Pr. 55.



 Terminal AM is factory-set to provide a 10VDC output in the full-scale state of each monitored data. Pr. 901 allows the output voltage ratio (gain) to be adjusted according to the meter reading. Note that the maximum output voltage is 10VDC.

(1) Calibration of terminal FM

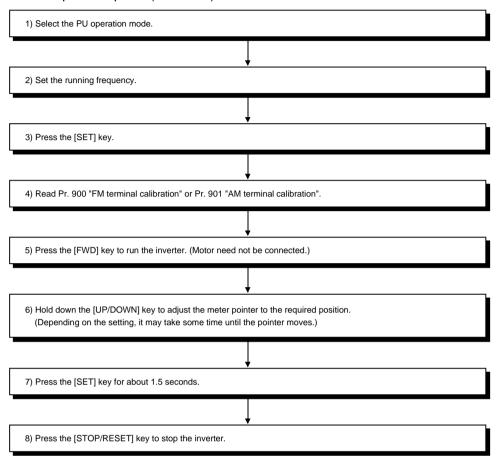
- 1) Connect a meter (frequency meter) across inverter terminals FM-SD. (Note the polarity. FM is the positive terminal.)
- 2) When a calibration resistor has already been connected, adjust the resistance to "0" or remove the resistor.
- 3) Set any of "1 to 3, 5 to 14, 17, 18 and 21" in Pr. 54. When the running frequency or inverter output current has been selected as the output signal, preset in Pr. 55 or Pr. 56 the running frequency or current at which the output signal is 1440Hz. At this 1440Hz, the meter normally deflects to full scale.

(2) Calibration of terminal AM

- 1) Connect a 0-10VDC meter (frequency meter) across inverter terminals AM-5. (Note the polarity. AM is the positive terminal.)
- 2) Set any of "1 to 3, 5 to 14, 17, 18 and 21" in Pr. 158. When the running frequency or inverter output current has been selected as the output signal, preset in Pr. 55 or Pr. 56 the running frequency or current at which the output signal is 10V.
- 3) When outputting a signal which cannot achieve a 100% value easily by operation, e.g. output current, set "21" in Pr. 158 and perform the following operation. After that, set "2" (output current, for example) in Pr. 158.

<Operation procedure>

When operation panel (FR-DU04) is used



Note: 1. Pr. 900 is factory-set to 1mA full-scale or 1440Hz FM output frequency at 60Hz. The maximum pulse train output of terminal FM is 2400Hz.

- When a frequency meter is connected across terminals FM-SD to monitor the running frequency, the FM terminal output is filled to capacity at the factory setting if the maximum output frequency reaches or exceeds 100Hz. In this case, the Pr. 55 setting must be changed to the maximum frequency.
- 3. For the operation procedure using the parameter unit (FR-PU04), refer to the FR-PU04 instruction manual.

Pr. 902 "frequency setting voltage bias"

Pr. 903 "frequency setting voltage gain"

Pr. 904 "frequency setting current bias"

Pr. 905 "frequency setting current gain"

Related parameters

Pr. 20 "acceleration/deceleration reference frequency"

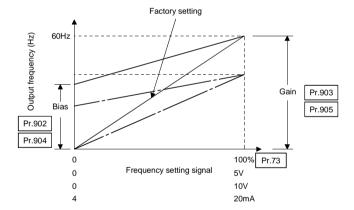
Pr. 73 "0-5V/0-10V selection"

You can set the output frequency as desired in relation to the frequency setting signal (0 to 5V, 0 to 10V or 4 to 20mA DC).

The "bias" and "gain" functions are used to adjust the relationship between the input signal entered from outside the inverter to set the output frequency, e.g. 0 to 5VDC, 0 to 10VDC or 4 to 20mADC, and the output frequency.

- Use Pr. 902 to set the bias frequency at 0V.
- Use Pr. 903 to set the output frequency relative to the frequency command voltage set in Pr. 73.
- Use Pr. 904 to set the bias frequency at 4mA.
- Use Pr. 905 to set the output frequency relative to the 20mA frequency command current (4 to 20mA).

Parameter Number	Facto	ory Setting	Setting Range		
902	0V	0Hz	0 to 10V	0 to 60Hz	
903	5V	60Hz	0 to 10V	1 to 400Hz	
904	4mA	0Hz	0 to 20mA	0 to 60Hz	
905	20mA	60Hz	0 to 20mA	1 to 400Hz	



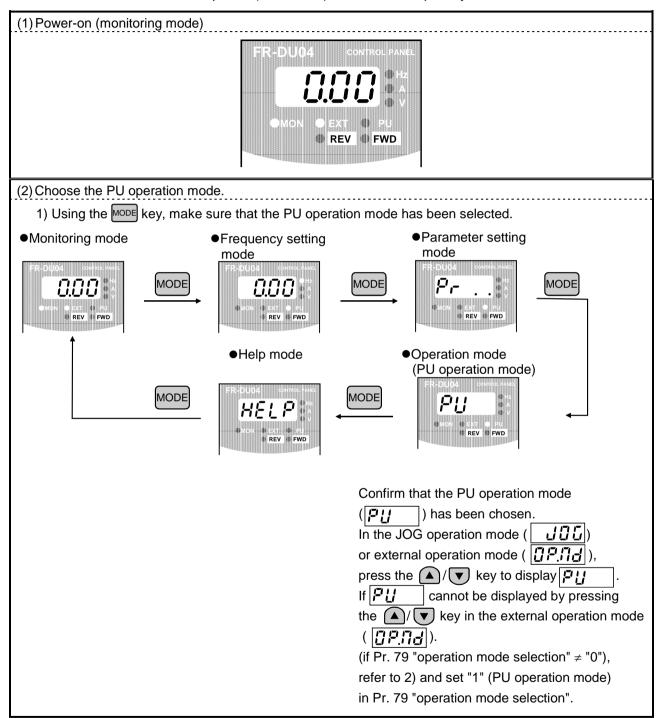
<Setting>

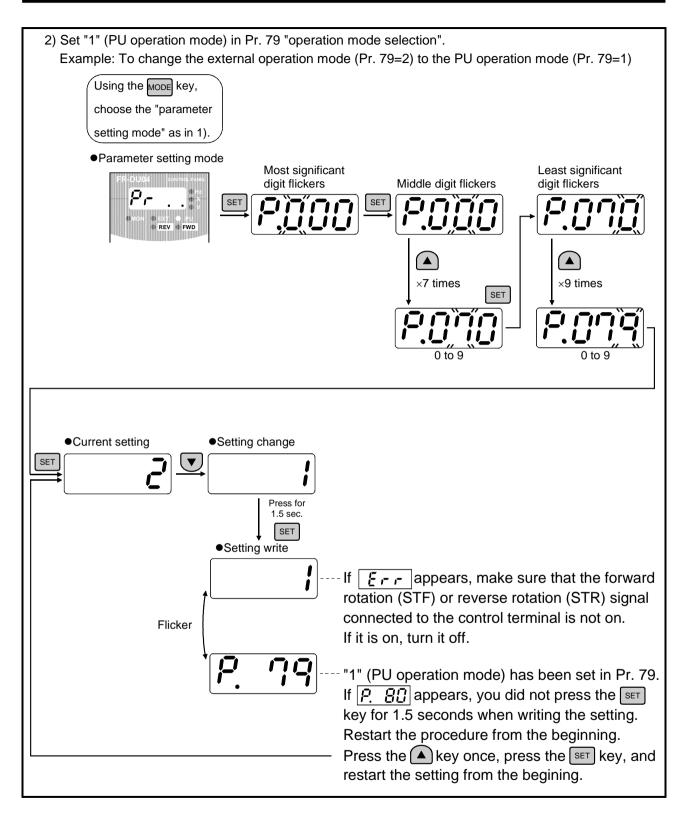
- (1) The frequency setting voltage biases and gains may be adjusted in either of the following three ways:
 - 1) Any point can be adjusted with a voltage applied across terminals 2-5.
 - 2) Any point can be adjusted with no voltage applied across terminals 2-5.
 - 3) Bias voltage is not adjusted.
- (2) The frequency setting current biases and gains may be adjusted in either of the following three ways:
 - 1) Any point can be adjusted with a current flowing at terminal 4.
 - 2) Any point can be adjusted with no current flowing at terminal 4.
 - 3) Bias current is not adjusted.

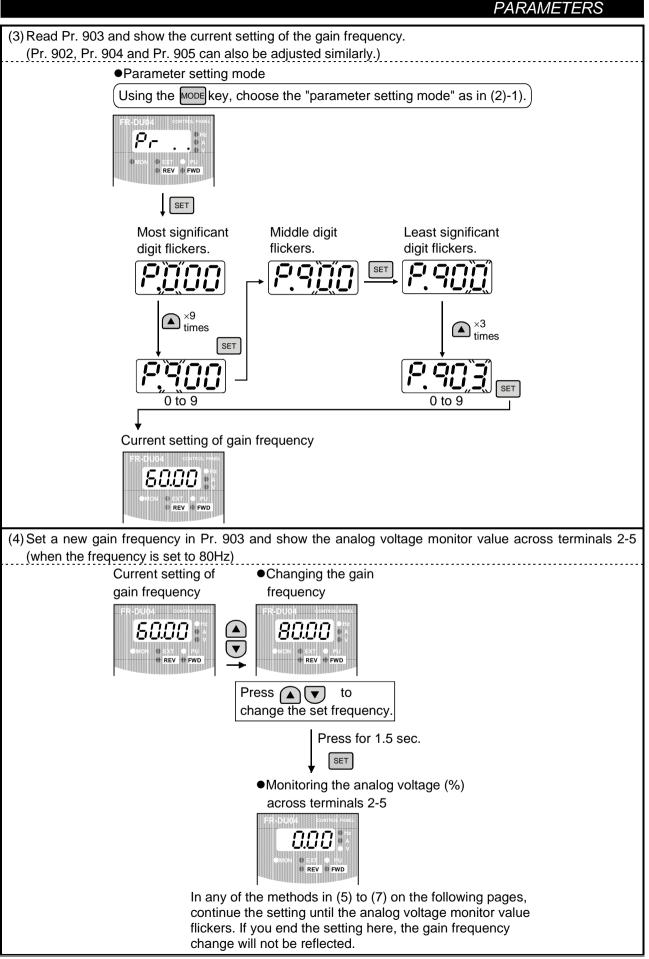
Pr. 903 "frequency setting voltage gain"

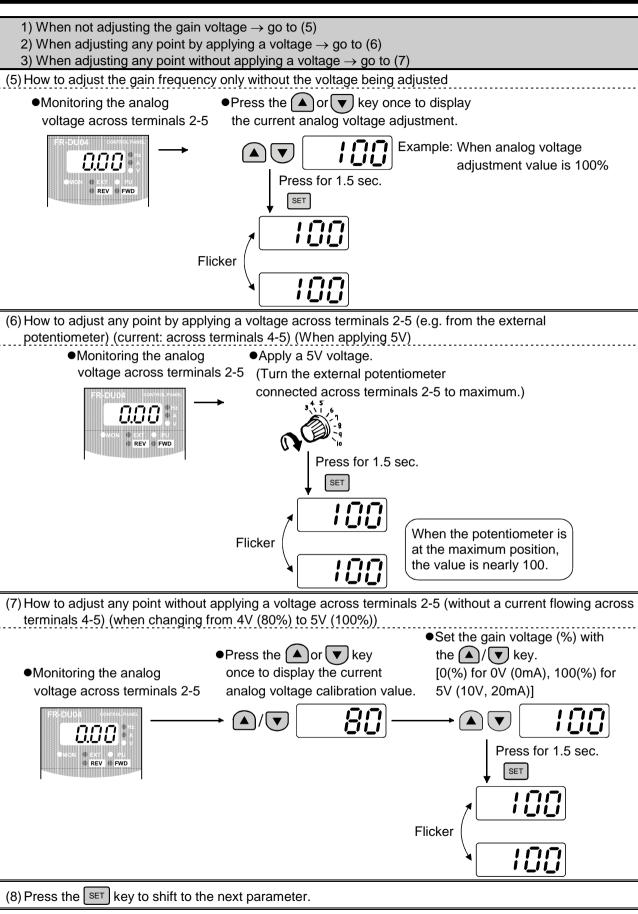
(Pr.902, Pr. 904, Pr. 905 can also be adjusted similarly.)

<Adjustment procedure When using the frequency setting signal from the operation panel (FR-DU04) to set the frequency.









(9) Re-set Pr. 79 "operation mode" according to the operation mode to be used.

PARAMETERS

Note: 1. If the Pr. 903 or Pr. 905 (gain adjustment) value is changed, the Pr. 20 value does not change.

2. When the Pr. 903 or Pr. 905 value is set, the value of Pr. 38 "frequency at 5V (10V) input" or Pr. 39 "frequency at 20mA input" changes automatically.



Provided the setting the bias frequency at 0V to any value other than "0". Even without the speed command, the motor will start running at the set frequency by merely switching on the start signal.

Pr. 990 "buzzer control"

You can make the buzzer "beep" when you press any key of the operation panel or parameter unit.

Parameter Number	Factory Setting	Setting Range	Remarks
990	1	0, 1	0: Without beep, 1: With beep

MEMO

CHAPTER 5 PROTECTIVE FUNCTIONS

This chapter explains the "protective functions" of this product.

Always read the instructions before using the equipment.

5.1 Errors (Alarms)	172
5.2 Troubleshooting	183
5.3 Precautions for Maintenance and Inspection	

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

If any fault has occurred in the inverter, the corresponding protective function is activated to bring the inverter to an alarm stop and automatically give the corresponding error (alarm) indication on the PU display. If your fault does not correspond to any of the following errors or if you have any other problem, please contact your sales representative.

- When the protective function is activated, take the corresponding corrective action, then reset the inverter, and resume operation.
- Resetting method

When the protective function is activated and the inverter has stopped its output, the inverter output is kept stopped (and the motor is coasted to a stop). Unless reset, therefore, the inverter cannot restart. To reset, use any of the following methods: switch power off once, then on again; short reset terminal RES-SD for more than 0.1 seconds, then open; or press the [RESET] key of the operation panel or parameter unit (use the help function of the parameter unit). If RES-SD are kept shorted, the operation panel shows "Err." and the parameter unit indicates that the inverter is being reset.

5.1.1 Error (alarm) definitions

(1) Major faults

Operation Panel Indication	E.OC1	E.D.C	1	FR-PU04	OC During Acc				
Name	Overcur	rent shut-off	durir	ng acceleration	n				
Description	When the inverter output current reaches or exceeds approximately 200% of the rated current during acceleration, the protective circuit is activated to stop the inverter output.								
Check point	Check for sudden acceleration. Check for output short circuit.								
Corrective action	Increase	the accelera	Increase the acceleration time.						

Operation Panel Indication	E.OC2	5.002	FR-PU04	Stedy Spd OC			
Name	Overcur	rent shut-off durir	ng constant sp	eed			
Description	rated cu	When the inverter output current reaches or exceeds approximately 200% of the rated current during constant speed, the protective circuit is activated to stop the inverter output.					
Check point		Check for sudden load change. Check for output short circuit.					
Corrective action	Keep loa	Keep load stable.					

Operation Panel Indication	E.OC3	E.003	FR-PU04	OC During Dec			
Name	Overcur	rent shut-off durir	ng deceleration	า			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated current during deceleration (other than acceleration or constant speed), the protective circuit is activated to stop the inverter output.						
Check point	Check for sudden speed reduction. Check for output short circuit. Check for too fast operation of motor's mechanical brake.						
Corrective action		the deceleration nechanical brake					

Operation Panel Indication	E.OV1	E.O	;	FR-PU04	OV During Acc				
Name	Regene	Regenerative overvoltage shut-off during acceleration							
Description	reach or	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.							
Check point	Check f	Check for too slow acceleration.							
Corrective action	Decreas	Decrease the acceleration time.							

Operation Panel Indication	E.OV2	E.O 2	FR-PU04	Stedy Spd OV					
Name	Regene	Regenerative overvoltage shut-off during constant speed							
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.								
Check point	Check for sudden load change.								
Corrective action	• Keep I	Keep load stable.							

Operation Panel Indication	E.OV3	E.O 3	FR-PU04	OV During Dec				
Name	Regene	rative overvoltage	shut-off durin	g deceleration or stop				
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.							
Check point	Check fo	Check for sudden speed reduction.						
Corrective action	GD ²)	• Increase the deceleration time. (Set the deceleration time which meets load						

Operation Panel Indication	E.THM	E.F.H.	7	FR-PU04	Motor Ovrload		
Name	Motor o	verload shut-o	off (e	electronic over	current protection) (Note 1)		
Description	to overlow When 8 When the inverse more more	oad or reduce 5% of the pre ne specified varter output. Wo otors are run,	d co set v alue hen prov	ooling capability value is reached, the a special mot vide a thermal	the inverter detects motor overheat due y during constant-speed operation. ed, pre-alarm (TH indication) occurs. e protective circuit is activated to stop or such as a multi-pole motor or two or relay in the inverter output side since electronic overcurrent protection.		
Check point	Check the motor for use under overload.						
Corrective action	Reduce	the load weig	ht.				

Operation Panel Indication	E.THT	E.F.H.F	FR-PU04	Inv. Overload			
Name	Inverter	overload shut-off	(electronic ov	ercurrent protection) (Note 1)			
Description	If a current of more than 150% of the rated output current flows and overcurrent shut-off does not occur (200% or less), inverse-time characteristics cause the electronic overcurrent protection to be activated to stop the inverter output in order to protect the output transistors. (Overload immunity 150%, 60 seconds.)						
Check point	Check the motor for use under overload.						
Corrective action	Reduce	the load weight.					

Note 1: Resetting the inverter initializes the internal <u>heat integrating data of the electronic overcurrent protection.</u>

Operation Panel Indication	E.IPF	EI	PF	FR-PU04	Inst. Pwr. Loss			
Name	Instanta	neous	power failu	re protection				
Description	If a power failure occurs for longer than 15ms (this also applies to inverter input shut-off), the instantaneous power failure protective function is activated to stop the inverter output in order to prevent the control circuit from malfunctioning. At this time, the alarm warning output contacts open (across terminals B-C) and close (across terminals A-C). (Note 2) If a power failure persists for longer than 100ms, the alarm warning output is not provided, and the inverter restarts if the start signal is on upon power restoration. (The inverter continues operating if an instantaneous power failure is within 15ms.)							
Check point	Find the	Find the cause of instantaneous power failure occurrence.						
Corrective action	Prepare	re a bad e function	ckup powe		ure. stantaneous power failure. fter instantaneous power failure. (Refer			

Note 2: When an instantaneous power failure occurs, the alarm display and alarm output are not provided, but the inverter performs protective operation to prevent a fault from occurring in itself. In some operating status (load size, acceleration/deceleration time setting, etc.), overcurrent or other protection may be activated upon power restoration.

Operation Panel Indication	E.UVT	EUUT	FR-PU04	Under Voltage			
Name	Undervo	ltage protection					
Description	If the power supply voltage of the inverter reduces, the control circuit will not operate properly and will result in decreased motor torque or increased heat generation. To prevent this, if the power supply voltage reduces below 440V, this function stops the inverter output. When a jumper is not connected across P-P1, the undervoltage protective function is activated.						
Check point	Check for start of large-capacity motor. Check that a jumper or DC reactor is connected across terminals P-P1.						
Corrective action		Check the power supply system equipment such as power supply. Connect a jumper or DC reactor across terminals P-P1.					

Operation Panel Indication	E.FIN	E.F.I. n	FR-PU04	H/Sink O/Temp			
Name	Fin over	Fin overheat					
Description	If the co	If the cooling fin overheats, the overheat sensor is actuated to stop the inverter output.					
Check point		Check for too high ambient temperature. Check for cooling fin clogging.					
Corrective action	Set the	Set the ambient temperature to within the specifications.					

Operation Panel Indication	E.GF	E.	GF	FR-PU04	Ground Fault		
Name	Output	Output side ground fault overcurrent protection					
Description	a groun	This function stops the inverter output if a ground fault overcurrent flows due to a ground fault which occurred in the inverter's output (load) side at the start of the inverter.					
Check point	Check f	Check for a ground fault in the motor and connection cable.					
Corrective action	Remedy	Remedy the ground fault portion.					

Operation Panel Indication	E.OHT	E.OHF	FR-PU04	OH Fault		
Name	Externa	thermal relay op	eration (Note 3	3)		
Description	If the external thermal relay designed for motor overheat protection or the internally mounted temperature relay in the motor switches on (contacts open), the inverter output is stopped. If the relay contacts are reset automatically, the inverter will not restart unless it is reset.					
Check point	 Check for motor overheating. Check that the value of 7 (OH signal) is set correctly in any of Pr. 180 to Pr. 186 (input terminal function selection). 					
Corrective action	Reduce	the load and ope	rating duty.			

Note 3: The output terminals used must be allocated using Pr. 190 to Pr. 195 (output terminal function selection). This function is activated only when OH has been set to any of Pr. 180 to Pr. 186 (input terminal function selection).

Operation Panel Indication	E.BE	E.	<i>68</i>	FR-PU04	Br. Cct. Fault			
Name	Brake tr	Brake transistor alarm detection						
Description	this fund	If the brake circuit fault has occurred due to damaged brake transistors, etc., this function stops the inverter output. In this case, the inverter power must be switched off immediately.						
Check point	 Reduce load GD² Check that the frequency of useing the brake is proper. 							
Corrective action	Change	the inv	erter.					

Operation Panel Indication	E.OLT	E.OL F	FR-PU04	Still Prev STP (OL shown during stall prevention operation)			
Name	Stall pre	Stall prevention					
Description		The running frequency has fallen to 0 by stall prevention activated. (OL while stall prevention is being activated.)					
Check point	Check the motor for use under overload.						
Corrective action	Reduce the load weight.						

Operation Panel Indication	E.OPT	E.OPT	FR-PU04	Option Fault				
Name	Option a	Option alarm						
Description	setting e	error or connection	n (connector) t tor converter c	connection is selected, this alarm				
Check point								
Corrective action								

Operation Panel Indication	E.OP1 to OP3	6.0P1 ~ 0P3	FR-PU04	Option slot alarm 1 to 3				
Name	Option s	Option slot alarm						
Description		Stops the inverter output if a functional alarm occurs in the plug-in option loaded in the corresponding slot (e.g. communication alarm of the communication option).						
Check point	Check for a wrong option function setting and operation. (1 to 3 indicate the option slot numbers.)							
Corrective action	Confirm the option function setting, etc.							

Operation Panel Indication	E.PE	Ŀ.	PE	FR-PU04	Corrupt Memry			
Name	Parame	Parameter storage device alarm						
Description	-	Stops the inverter output if a fault occurs in the E ² PROM device which stores parameter settings.						
Check point	Check for too many number of parameter write times.							
Corrective action	Change the inverter.							

Operation Panel Indication	E.PUE	E.PUE	FR-PU04	PU Leave Out					
Name	Parame	ter unit disconnec	tion						
Description	and PU "3", "16' stop sel success retries v connect	This function stops the inverter output if communication between the inverter and PU is suspended, e.g. the operation panel or PU is disconnected, when "2", "3", "16" or "17" was set in Pr. 75 "reset selection/disconnected PU detection/PU stop selection". This function stops the inverter output if the number of successive communication errors is greater than the permissible number of retries when the Pr. 121 value is "9999" for RS-485 communication from the PU connector. This function stops the inverter output if communication is broken for the time set in Pr. 122.							
Check point		for loose fitting o the Pr. 75 setting		J.					
Corrective action	Fit the D	OU and PU secure	ely.						
Operation Panel Indication	E.RET	E E.	FR-PU04	Retry No Over					
Name	Retry co	Retry count exceeded							
Description	1 -	If operation cannot be resumed properly within the number of retries set, this function stops the inverter output.							
Check point	Find the	cause of alarm o	ccurrence.						
Corrective action	Eliminat	te the cause of the	e error precedi	ng this error indication.					
Operation Panel Indication	E.CPU	E.C.P.U	FR-PU04	CPU Fault					
Name	CPU err	ror							
Description		If the arithmetic operation of the built-in CPU does not end within a predetermined period, the inverter self-determines it as an alarm and stops the output.							
Check point									
Corrective action	Make	Make connection securely.							
Operation Panel Indication	E. 6	<i>E.</i> 8	FR-PU04	CPU error					
Name	CPU err	CPU error							
Description	end with	If the arithmetic operation of the peripheral circuit of the built-in CPU does not end within a predetermined period, the inverter self-determines it as an alarm and stops the output.							
Check point	Check f	or a loose connec	tor.						
Corrective action	• Make	Make connection securely.							

Operation Panel Indication	E. 7	E.	7	FR-PU04	CPU error			
Name	CPU err	CPU error						
Description	end with	If the arithmetic operation of the peripheral circuit of the built-in CPU does not end within a predetermined period, the inverter self-determines it as an alarm and stops the output.						
Check point								
Corrective action	Make connection securely.							

Operation Panel Indication	E.P24	<i>E.P.2</i> 4.3	FR-PU04					
Name	24VDC	24VDC power output short circuit						
Description	When the 24VDC power output from the PC terminal is shorted, this function shuts off the power output. At this time, all external contact inputs switch off. The inverter cannot be reset by entering the RES signal. To reset, use the operation panel or switch power off, then on again.							
Check point	Check for a short circuit in the PC terminal output.							
Corrective action	Remedy	the short circuit	oortion.					

Operation Panel Indication	E.CTE	E.C.F.E	FR-PU04				
Name	Operation panel power supply short circuit						
Description	this fund (parame	ction shuts off the eter unit) cannot b or cannot be mad	power supply e used and RS	y (P5S of the PU connector) is shorted, output. At this time, the operation panel S-485 communication from the PU other the RES signal or switch power off,			
Check point	Check for a short circuit in the PU connector cable.						
Corrective action	Check th	ne PU and cable.					

Operation Panel Indication	E.LF	E.L.F	FR-PU04					
Name	Output phase failure protection							
Description	This function stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) results in open phase.							
Check point	Check the wiring (Check the motor for a fault.)							
Corrective action	• Wire tl	ne cables properly	y					

Operation Panel Indication	E.MB1 to MB7 FR-PU04 FR-PU04							
Name	Brake sequence error							
Description	This function stops the inverter output if a sequence.							
Check point	Check brake sequence.							
Corrective action	Check the set parameters and wire correctly.							

(2) Minor fault

Operation Panel Indication	FN	Fn	FR-PU04	Fan fault				
Name	Fan fault							
Description	For the inverter which contains a cooling fan, FN appears on the operation panel when the cooling fan stops due to a fault or operates differently from the setting of Pr. 244 "cooling fan operation selection".							
Check point	Check the cooling fan for a fault.							
Corrective action	Change the fan.							

(3) Warnings

Operation Panel Indication	OL	0L		FR-PU04	OL (Stall Prev STP)	
Name	Stall prevention (Over current)					
	During freque inverte overloom			f a current of more than 150% (Note 4) of the rated inverter current flows in the motor, this function stops the increase in requency until the overload current reduces to prevent the overter from resulting in overcurrent shut-off. When the overload current has reduced below 150%, this function increases the frequency again.		
Description	During constant- speed operation currer until t shut-o		curren until tl shut-o	f a current of more than 150% (Note 4) of the rated inverter current flows in the motor, this function lowers the frequency until the overload current reduces to prevent overcurrent shut-off. When the overload current has reduced below 50%, this function increases the frequency up to the set value.		
	During decelera	ation	If a current of more than 150% (Note 4) of the rated invertible current flows in the motor, this function stops the decrease frequency until the overload current reduces to prevent inverter from resulting in overvoltage shut-off. When overload current has reduced below 150%, this funct decreases the frequency again.			
Check point	Check t	he motor f	or use u	ınder overload	1 .	
Corrective action	The acceleration/deceletion time may change. Increase the stall prevention operation level with Pr. 22 "stall prevention operation level" or disable stall prevention with Pr. 156 "stall prevention operation selection".					

Note 4: The stall prevention operation current may be set as desired. It is factory-set to 150%.

Operation Panel Indication	oL	oL		FR-PU04	oL	
Name	Stall prevention (overvoltage			age)		
Description	During decrea			ceed the bra ase in frequer as the regene	energy of the motor increases too much ake capability, this function stops the ncy to prevent overvoltage shut-off. As rative energy has reduced, deceleration	
Check point	Check for sudden speed reduction.					
Corrective action	The deceleration time may change. Increase the deceleration time with Pr. 8 "deceleration time".					

Operation Panel Indication	PS	<i>P</i> 5	FR-PU04	PS				
Name	PU stop							
Description	•	A stop made by pressing the [STOP] key of the PU has been set in Pr. 75 "PU stop selection".						
Check point	Check for a stop made by pressing the STOP key of the operation panel.							
Corrective action	Refer to page 90.							

Operation Panel Indication	Err.	Err
Description	The RYou atYou atCommA paraYou a	rm appears if: ES signal is on. Itempted to set any parameter value in the external operation mode. Itempted to change the operation mode during operation. Itempted to set any parameter value outside its setting range. Itempted to set any parameter value outside its setting range. Itempted is not made properly between PU and inverter. Itempted value was set during operation (while signal STF or STR is ON). Itempted to set a parameter value when Pr. 77 "parameter write disable tion" had been set to disable parameter write.
Corrective action	Perform	operation correctly.

5.1.2 To know the operating status at the occurrence of an alarm

When any alarm has occurred, the display automatically switches to the indication of the corresponding protective function (error). By pressing the [MODE] key at this point without resetting the inverter, the display shows the output frequency. In this way, it is possible to know the running frequency at the occurrence of the alarm. It is also possible to know the current in the same manner. However, these values are not stored in memory and are erased when the inverter is reset.

5.1.3 Correspondences between digital and actual characters

There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the operation panel:

Actual	Digital
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Actual	Digital
A	Æ
В	
C	
D	
E	E
F	<i> </i>
G	
Н	
J	
L	

Actual	Digital
M	[7]
N	
0	
0	
Р	
s	5
T	
U	
V	
r	 -
-	-

5.1.4 Alarm code output

By setting Pr. 76 "alarm code output selection", an alarm definition can be output as a 4-bit digital signal. This signal is output from the open collector output terminals equipped as standard on the inverter. Correlations between alarm definitions and alarm codes are as follows.

Operation Panel	Out	Output Terminal Signal On-Off				
Display (FR-DU04)	SU	IPF	OL	FU	Alarm Code	Alarm Output (across B-C)
E.OC1	0	0	0	1	1	
E.OC2	0	0	1	0	2	Provided (Open)
E.OC3	0	0	1	1	3	
E.OV1						
E.OV2	0	1	0	0	4	Provided (Open)
E.OV3						
E.THM	0	1	0	1	5	Provided (Open)
E.THT	0	1	1	0	6	Provided (Open)
E.IPF	0	1	1	1	7	Provided (Open)
E.UVT	1	0	0	0	8	Provided (Open)
E.FIN	1	0	0	1	9	Provided (Open)
E. BE	1	0	1	0	Α	Provided (Open)
E. GF	1	0	1	1	В	Provided (Open)
E.OHT	1	1	0	0	С	Provided (Open)
E.OLT	1	1	0	1	D	Not provided (Provided when OLT is displayed) (Open)
E.OPT	1	1	1	0	E	Provided (Open)
E.OP1 to E.OP3	1	1	1	0	E	Provided (Open)
E. PE						Provided (Open)
E.PUE						Provided (Open)
E.RET						Provided (Open)
E.LF	1	1	1	1	F	Provided (Open)
E.CPU						Provided (Open)
E. 6						Provided (Open)
E. 7						Provided (Open)

(Note) 0: Output transistor OFF, 1: Output transistor ON (common terminal SE)
The alarm output assumes that Pr. 195 setting is "99" (factory setting).

5.1.5 Resetting the inverter

The inverter can be reset by performing any of the following operations. Note that the electronic overcurrent protection's internal heat calculation value and the number of retries are cleared (erased) by resetting the inverter.

Operation 1: Using the operation panel (FR-DU04), press the [RESET] key to reset the inverter.

Operation 2: Switch power off once, then switch it on again.

Operation 3: Switch on the reset signal (RES).

5.2 Troubleshooting

PROTECTIVE FUNCTIONS

POINT: Check the corresponding areas. If the cause is still unknown, it is recommended to initialize the parameters (return to factory settings), re-set the required parameter values, and check again.

5.2.1 Motor remains stopped.

- 1) Check the main circuit
 - Check that a proper power supply voltage is applied (operation panel display is provided).
 - Check that the motor is connected properly.
- 2) Check the input signals
 - Check that the start signal is input.
 - Check that both the forward and reverse rotation start signals are not input.
 - Check that the frequency setting signal is not zero.
 - Check that the AU signal is on when the frequency setting signal is 4 to 20mA.
 - Check that the output stop signal (MRS) or reset signal (RES) is not on.
 - Check that the CS signal is not off when automatic restart after instantaneous power failure is selected (Pr. 57 = other than "9999").
- 3) Check the parameter settings
 - Check that the Pr. 160 "user group read selection" setting is correct.
 - Check that the reverse rotation prevention (Pr. 78) is not selected.
 - Check that the operation mode (Pr. 79) setting is correct.
 - Check that the bias and gain (Pr. 902 to Pr. 905) settings are correct.
 - Check that the starting frequency (Pr. 13) setting is not greater than the running frequency.
 - Check that various operational functions (such as three-speed operation), especially the maximum frequency (Pr. 1), are not zero.
- 4) Check the load
 - Check that the load is not too heavy.
 - Check that the shaft is not locked.
- Others
 - Check that the ALARM lamp is not lit.
 - Check that the Pr. 15 "jog frequency" setting is not lower than the Pr. 13 "starting frequency" value.

5.2.2 Motor rotates in opposite direction.

- Check that the phase sequence of output terminals U, V and W is correct.
- Check that the start signals (forward rotation, reverse rotation) are connected properly.

5.2.3 Speed greatly differs from the setting.

- Check that the frequency setting signal is correct. (Measure the input signal level.)
- Check that the following parameter settings are proper: Pr. 1, Pr. 2, Pr. 902 to Pr. 905, Pr. 19.
- Check that the input signal lines are not affected by external noise. (Use shielded cables)
- Check that the load is not too heavy.

5.2.4 Acceleration/deceleration is not smooth.

- Check that the acceleration and deceleration time settings are not too short.
- Check that the load is not too heavy.
- Check that the torque boost (Pr. 0, Pr. 46, Pr. 112) setting is not too large to activate the stall function.

5.2.5 Motor current is large.

- Check that the load is not too heavy.
- Check that the torque boost (Pr. 0, Pr. 46, Pr. 112) setting is not too large.

5.2.6 Speed does not increase.

- Check that the maximum frequency (Pr. 1) setting is correct.
- Check that the load is not too heavy. (In agitators, etc., load may become heavy in winter.)
- Check that the torque boost (Pr. 0, Pr. 46, Pr. 112) setting is not too large to activate the stall prevention function.
- Check that the breake resistor is not connected to terminals P-P1 accidentally.

5.2.7 Speed varies during operation.

During operation under advanced magnetic flux vector control, the output frequency varies with load fluctuation between 0 and 2Hz. This is a normal operation and is not a fault.

- 1) Inspection of load
 - Check that the load is not varying.
- 2) Inspection of input signal
 - Check that the frequency setting signal is not varying.
 - Check that the frequency setting signal is not affected by induced noise.
- 3) Others
 - Check that the settings of the applied motor capacity (Pr. 80) and the number of applied motor poles (Pr. 81) are correct for the inverter and motor capacities in advanced magnetic flux vector control.
 - Check that the wiring length is within 30m (98.42 feet) in advanced magnetic flux vector control.
 - Check that the wiring length is correct in V/F control.

5.2.8 Operation mode is not changed properly.

If the operation mode is not changed properly, check the following:

1. External input signal Check that the STF or STR signal is off.

When it is on, the operation mode cannot be changed.

When the setting of Pr. 79 "operation mode selection" is "0" (factory setting), switching input power on places the inverter in the external operation mode. Press the operation panel's [MODE] key three times and press the [UP] key (press the [PU] key for the parameter unit

(FR-PU04)). This changes the external operation mode into the PU operation mode. For any other setting (1 to 8), the operation mode is limited according to the setting.

5.2.9 Operation panel (FR-DU04) display is not provided.

Make sure that the operation panel is connected securely with the inverter.

5.2.10 POWER lamp is not lit.

Make sure that the wiring and installation are correct.

5.2.11 Parameter write cannot be performed

- Check that operation is not being performed (signal STF or STR is not ON).
- Check that the [SET] key ([WRITE] key) is pressed for longer than 1.5 seconds.
- Check that you are not attempting to make parameter setting outside the setting range.
- Check that you are not attempting to make parameter setting in the external operation moed.
- Check the setting of Pr. 77 "parameter write inhibit selection".

5.3 Precautions for Maintenance and Inspection

PROTECTIVE FUNCTIONS

The transistorized inverter is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to adverse influence by the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

5.3.1 Precautions for maintenance and inspection

For some short time after the power is switched off, a high voltage remains in the smoothing capacitor. When accessing the inverter for inspection, switch power off. When more than 10 minutes have elapsed, make sure that the voltage across the main circuit terminals P-N of the inverter is 30VDC or less using a tester, etc.

5.3.2 Check items

(1) Daily inspections

- Check the following:
 - 1) Motor operation fault
 - 2) Improper installation environment
 - 3) Cooling system fault
 - 4) Unusual vibration and noise
 - 5) Unusual overheating and discoloration
- During operation, check the inverter input voltages using a tester.

(2) Cleaning

Always run the inverter in a clean state.

When cleaning the inverter, gently wipe dirty areas with a soft cloth immersed in neutral detergent or ethanol.

Note: Do not use solvent, such as acetone, benzene, toluene and alcohol, as they will cause the inverter surface paint to peel off.

Do not use detergent or alcohol to clean the display and other sections of the operation panel (FR-DU04) or parameter unit (FR-PU04) as these sections do not like them.

5.3.3 Periodic inspection

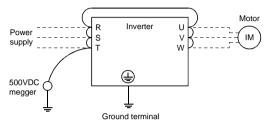
Check the areas inaccessible during operation and requiring periodic inspection. For periodic inspection, consult us.

- 1) Cooling system:.....Clean the air filter, etc.
- 2) Screws and bolts:These parts may become loose due to vibration, temperature changes, etc.

 Check that they are tightened securely and retighten as necessary.
- 3) Conductors and insulating materials: Check for corrosion and damage.
- 4) Insulation resistance: Measure.
- 5) Cooling fan, smoothing capacitor, relay: Check and change if necessary.

5.3.4 Insulation resistance test using megger

- 1) Before performing the insulation resistance test using a megger on the external circuit, disconnect the cables from all terminals of the inverter so that the test voltage is not applied to the inverter.
- 2) For the continuity test of the control circuit, use a meter (high resistance range) and do not use the megger or buzzer.
- 3) For the inverter, conduct the insulation resistance test on the main circuit only as shown below and do not perform the test on the control circuit. (Use a 500VDC megger.)



5.3.5 Pressure test

Do not conduct a pressure test. The inverter's main circuit uses semiconductors, which may be deteriorated if a pressure test is made.

Daily and Periodic Inspection

Area of			Interval					
Inspec-	Inspection	Description		Peri		Method	Criterion	Instrument
tion	Item		Daily	1 vear	2 vears		C	
General	Surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	0	your	your	(Refer to page 7)	Ambient temperature: (constant torque) -10°C to +40°C, non-freezing. (Variable torque) -10°C to +40°C, non-freezing Ambient humidity: 90% or less, non-condensing.	Thermometer, hygrometer, recorder
	Overall unit	Check for unusual vibration and noise.	0			Visual and auditory checks.	No fault.	
	Power supply voltage	Check that main circuit voltage is normal.	0			Measure voltage across inverter terminals R-S-T	Within permissible AC voltage fluctuation (Refer to page 193)	Meter, digital multimeter
Main circuit	General	 Check with megger (across main circuit terminals and ground terminal). Check for loose screws and bolts. Check for overheating of each part. Clean. 		0 0	0	(1) Disconnect all cables from inverter and measure across terminals R, S, T, V, W and ground terminal with megger. (2) Re-tighten. (3) Visual check.	(1) 5M Ω or more. (2), (3) No fault.	500VDC class megger
	Conductors, cables	(1) Check conductors for distortion.(2) Check cable sheaths for breakage.		0 0		(1), (2) Visual check.	(1), (2) No fault.	
	Terminal block	Check for damage.		0		Visual check.	No fault	

Daily and Periodic Inspection

Area of			Interval						
Inspec-	Inspection	Description	Daile	Periodic		Method	Criterion	Instrument	
tion	Item		Daily	1 year	2 years				
	Inverter module, Converter module	Check resistance across terminals.		Jun	0	Disconnect cables from inverter and measure across terminals R, S, T, P, N and U, V, W, P, with tester range of 100Ω .	Refer to page 188	Analog meter	
Main circuit	Smoothing capacitor	(1) Check for liquid leakage. (2) Check for safety valve projection and bulge. (3) Measure electrostatic capacity.	0	0		(1), (2) Visual check. (3) Measure with capacity meter.	(1), (2) No fault. (3) 85% or more of rated capacity.	Capacity meter	
	Relay	(1) Check for chatter during operation. (2) Check for rough surface on contacts.		0		(1) Auditory check. (2) Visual check.	(1) No fault. (2) No fault.		
	Resistor	(1) Check for crack in resistor insulation. (2) Check for open cable.		0		(1) Visual check. Cement resistor, wire-wound resistor. (2) Disconnect one end and measure with tester.	(1) No fault. (2) Error should be within ±10% of indicated resistance value.	Meter, digital multimeter	
Control circuit Protective circuit	Operation check	(1) Check balance of output voltages across phases with inverter operated independently. (2) Perform sequence protective operation test to make sure of no fault in protective and display circuits.		0		(1) Measure voltage across inverter output terminals U-V-W. (2) Simulatively connect or disconnect inverter protective circuit output terminals.	(1) Phase-to-phase voltage balance within 12V. (2) Fault must occur because of sequence.	Digital multimeter, rectifier type voltmeter	
Cooling system	Cooling fan	(1) Check for unusual vibration and noise.(2) Check for loose connection.	0	0		(1) Turn by hand with power off.(2) Re-tighten	No unusual vibration, unusual noise.		
	Display	(1) Check if LED lamp is blown. (2) Clean.	0	0		(1) Light indicator lamps on panel.(2) Clean with rag.	(1) Check that lamps are lit.		
Display	Meter	Check that reading is normal.	0			Check reading of meters on panel.	Must satisfy specified and management values.	Voltmeter, ammeter, etc.	
Motor	General	(1) Check for unusual vibration and noise.(2) Check for unusual odor.	0			(1) Auditory, sensory, visual checks.(2) Check for unusual odor due to overheating, damage, etc.	(1), (2) No fault.		
	Insulation resistance	(1) Check with megger (across terminals and ground terminal).			0	(1) Disconnect cables from U, V, W, including motor cables.	(1) 5M Ω or more	500V megger	

• Checking the inverter and converter modules

<Preparation>

- (1) Disconnect the external power supply cables (R, S, T) and motor cables (U, V, W).
- (2) Prepare a meter. (Use 100Ω range.)

<Checking method>

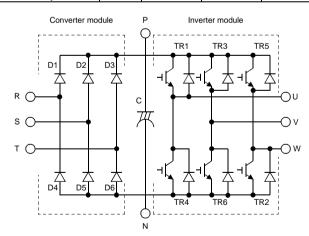
Change the polarity of the tester alternately at the inverter terminals R, S, T, U, V, W, P and N, and check for continuity.

Note: 1. Before measurement, check that the smoothing capacitor is discharged.

2. At the time of continuity, the measured value is several to several ten's-of ohms depending on the module type, circuit tester type, etc. If all measured values are almost the same, the modules are without fault.

<Module device numbers and terminals to be checked>

	Tester Polarity		Polarity	Measured Value		Tester	Polarity	Measured Value
		\oplus	Θ	Measured value		\oplus	Θ	wieasured value
e e	D1	R	Р	Discontinuity	D4	R	N	Continuity
module	וט	Р	R	Continuity	D4	Ν	R	Discontinuity
	D2	S	Р	Discontinuity	D5	S	N	Continuity
Converter	DZ	Р	S	Continuity	DS	Ν	S	Discontinuity
Ž	D3	Т	Р	Discontinuity	D6	Т	N	Continuity
ပိ		Р	Т	Continuity	Do	Ν	Т	Discontinuity
<u>e</u>	TR1	J	Р	Discontinuity	TR4	J	N	Continuity
module	IKI	Р	U	Continuity	1174	Ν	U	Discontinuity
	TR2	V	Р	Discontinuity	TR6	V	N	Continuity
ter	1142	Ρ	V	Continuity	IKO	Ν	V	Discontinuity
Inverter	TR5	W	Р	Discontinuity	TR2	W	N	Continuity
=	CZI	Р	W	Continuity	1152	N	W	Discontinuity



5

5.3.6 Replacement of parts

The inverter consists of many electronic parts such as semiconductor devices.

The following parts may deteriorate with age because of their structures or physical characteristics, leading to reduced performance or failure of the inverter. For preventive maintenance, the parts must be changed periodically.

Replacement Parts of the Inverter

Part Name	Standard Replacement Interval	Description
Cooling fan	2 to 3 years	Change (as required)
Smoothing capacitor in main circuit	5 years	Change (as required)
Smoothing capacitor on control board	5 years	Change the board (as required)
Relays		Change as required

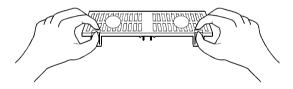
Note: For part replacement, contact the nearest MGI office.

(1) Cooling fan

The cooling fan cools heat-generating parts such as the main circuit semiconductor devices. The life of the cooling fan bearing is usually 10,000 to 35,000 hours. Hence, the cooling fan must be changed every 2 to 3 years if the inverter is run continuously. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be changed immediately.

Removal

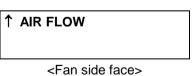
1) Push the catches from above and remove the fan cover.



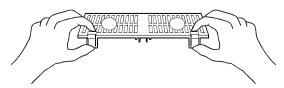
- 2) Disconnect the fan connector(s).
- 3) Remove the fan.

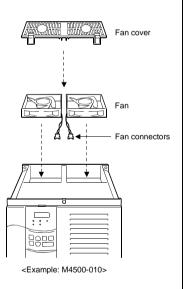
Reinstallation

1) After confirming the orientation of the fan, reinstall the fan so that the arrow on the left of "AIR FLOW" faces up.



- 2) Reconnect the fan connectors.
 - When wiring, use care to avoid the cables being caught by the fan.
- 3) Reinstall the fan cover.





(2) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing the DC in the main circuit, and an aluminum electrolytic capacitor is also used for stabilizing the control power in the control circuit. Their characteristics are adversely affected by ripple current, etc. When the inverter is operated in an ordinary, air-conditioned environment, change the capacitors about every 5 years. When 5 years have elapsed, the capacitors will deteriorate more rapidly.

Check the capacitors at least every year (less than six months if their life will be expired soon). Check the following:

- 1) Case (side faces and bottom face for expansion)
- 2) Sealing plate (for remarkable warping and extreme cracks)
- 3) Explosion-proof valve (for excessive valve expansion and operation)
- 4) Appearance, external cracks, discoloration, leakage. When the measured capacitance of the capacitor has reduced below 85% of the rating, change the capacitor.

(3) Relays

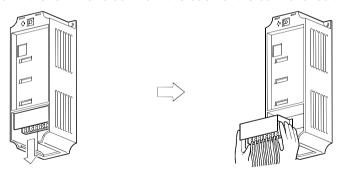
To prevent a contact fault, etc., relays must be changed according to the number of accumulative switching times (switching life).

See the following table for the inverter parts replacement guide. Lamps and other short-life parts must also be changed during periodic inspection.

5.3.7 Inverter replacement

The inverter can be changed with the control circuit wiring kept connected. Before replacement, remove the screws in the wiring cover of the inverter.

- 1) Remove the mounting screws in both ends of the control circuit terminal block.
- 2) With both hands, pull down the terminal block from the back of the control circuit terminals.



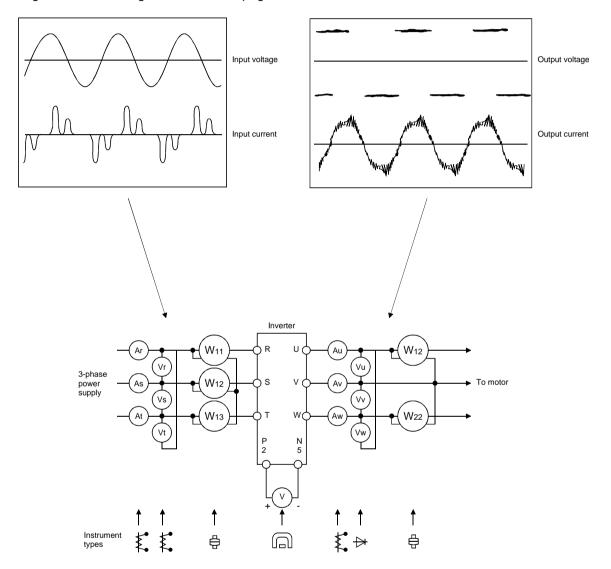
3) When installing the terminal block to a new inverter, exercise care not to bend the pins of the control circuit terminal block connector.

5.3.8 Measurement of main circuit voltages, currents and power

Measurement of voltages and currents

Since the voltages and currents on the inverter power supply and output sides include harmonics, accurate measurement depends on the instruments used and circuits measured.

When instruments for commercial frequency are used for measurement, measure the following circuits using the instruments given on the next page.



Typical Measuring Points and Instruments

Note: Use an FFT to measure the output voltage accurately. Accurate measurement cannot be made if you use a tester or general measuring instrument.

Measuring Points and Instruments

Item	Measuring Point	Measuring Instrument	Remarks (Reference Measured Value) *
Power supply voltage V ₁	Across R-S, S-T and T-R	Moving-iron type AC voltmeter	Commercial power supply Within permissible AC voltage fluctuation
Power supply side current I ₁	R, S and T line currents	Moving-iron type AC ammeter	
Power supply side power P ₁	At R, S and T, and across R-S, S-T and T-R	Electrodynamic type single- phase wattmeter	P1 = W11 + W12 + W13 (3-wattmeter method)
Power supply side power factor Pf ₁	Calculate after measuring power s power. $Pf_1 = \frac{P_1}{\sqrt{3} V_1 \times I_1} \times 100\%$	supply voltage, power supply side o	current and power supply side
Output side voltage V ₂	Across U-V, V-Wand W-U	Rectifier type AC voltmeter (Note 1) (Not moving-iron type)	Difference between phases is within ±1% of maximum output voltage.
Output side current l2	U, V and W line currents	Moving-iron type AC ammeter (Note 3)	Current should be equal to or less than rated inverter current. Difference between phases is 10% or lower.
Output side power P2	At U, V and W, and across U-V and V-W	Electrodynamic type single- phase wattmeter	P ₂ = W ₂₁ + W ₂₂ 2-wattmeter method (or 3-wattmeter method)
Output side power factor Pf ₂	Calculate in similar manner to power Pf ₂ = $\frac{P_2}{\sqrt{3} V_2 \times I_2} \times 100\%$	ver supply side power factor.	
Converter output	Across P-N	Moving-coil type (such as tester)	POWER lamp lit 1.35 × V ₁ Maximum 923V during regenerative operation
Frequency setting signal	Across 2 (+) +5 Across 1 (+) +5 Across 4 (+) +5		0 to 5V/0 to 10VDC 0 to ±5V/0 to ±10VDC 4 to 20mADC 5VDC
Frequency setting power supply	Across 10 (+) +5 Across 10E (+) +5		5VDC 10VDC
Frequency meter signal	Across FM (+) +SD	Moving-coil type (Tester, etc. may be used) (Internal resistance: 50kΩ or larger)	Approximately 5VDC at maximum frequency (without frequency meter) T1 8VDC Pulse width T1: Adjusted by Pr.900 Pulse cycle T2: Set by Pr.55 (Valid for frequency monitoring only)
	Across AM (+) +5		Approximately 10VDC at maximum frequency (without frequency meter)
Start signal Select signal Reset Output stop	Across STF, STR, RH, RM, RL, JOG, RT, AU, STOP, CS (+) +SD Across RES (+) +SD Across MRS (+) +SD		20 to 30VDC when open. ON voltage: 1V or less
Alarm signal	Across A-C Across B-C	Moving-coil type (such as tester)	Continuity check (Note 2)

Note

- 1. Accurate data will not be obtained by a tester.
- Accurate data will not be obtained by a tester.
 When Pr. 195 "A, B, C terminal function selection" setting is positive logic.
 When the carrier frequency exceeds 5kHz, do not use the instrument because overcurrent losses occurring in the metallic parts inside the instrument will increase and may lead to burnout.
 In this case, use an approximate effective value type instrument.

CHAPTER 6 SPECIFICATIONS

This chapter provides the "specifications" of this product. Always read the instructions before using the equipment.

6.1 Standard Specifications193

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

Chapter 7

6.1.1 Model specifications

●575V class

M4500-**				001	003	005	010	025	040	060	100
	plicable m		CT	1	3	5	10	20	30	50	75
	capacity (HP) (Note 1)		VT	1	1 3 5		10	25	40	60	100
	Rated			1.7	4	6.1	12	22	33	55	84
	capacity (kVA) (Note 2)		VT	1.8	4.7	7.3	14.8	27	41	62	99
	Continuo		CT	1.7	4	6.1	12	22	33	55	84
Ħ	current (A (Note 6)	A)	VT	1.8	4.7	7.3	14.8	27	41	62	99
Output	Overload	-	CT		15	50% 60 sec, 2	200% 0.5 sec	(inverse-time	characteristic	s)	
0	current rating (Note 3)		VT		1:	20% 60sec, 1	50% 0.5 sec	(inverse-time	characteristic	s)	
	Voltage (Note 4)			Three phase, 575V 60Hz							
	Regen erative	Max. value	time/		100% 5 sec 20% (Note 5)						
	braking Permitorque duty		issible		2%ED		Continuous (Note 5)				
	Rated input AC voltage, frequency				Three phase, 575V 60Hz						
flddr	_ , ,				490 to 632V 60Hz						
Power supply	Permissible frequency fluctuation		uation		±5%						
Po	Power supply system capacity (kVA) (Note 7)			2.5	5.5	9	17	28	41	66	100
	Protective structure (JEM 1030)				Enclosed type (IP20)						
Сс	Cooling system			Self- cooling	Forced air cooling						

- Note: 1. The applicable motor capacity indicated is the maximum capacity applicable when 4-pole standard motor is used.
 - 2. The rated output capacity indicated assumes that the output voltage is 575V for 575V class.
 - 3. The overload capacity indicated in % is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
 - 4. The maximum output voltage cannot exceed the power supply voltage. The maximum output voltage may be set as desired below the power supply voltage.
 - 5. The torque indicated is the average value for deceleration from 60Hz to a stop and varies with motor loss.
 - 6. When using VT, maximum carrier frequency is 8KHz.
 - 7. The power supply capacity changes with the value of the power supply side inverter impedances (including those of the input reactor and cables).

6.1.2 Common specifications

	Control system			Soft-PWM control/high carrier frequency PWM control (V/F control or					
				advanced magnetic flux vector control can be selected)					
		ut frequen	cy range	0.2 to 400Hz					
		uency	Analog input	0.015Hz/60Hz (terminal 2 input: 12 bits/0 to 10V, 11 bits/0 to 5V, terminal 1 input: 12 bits/-10					
S	setting			to +10V, 11 bits/-5 to +5V)					
ion	reso	ution	Digital input	0.01Hz					
Control specifications	Freq	uency acci	uracy	Within ±0.2% of maximum output frequency (25°C ±10°C (77°F ±18°F) for analog input, within 0.01% of set output frequency for digital input					
рес	Volta	age/frequer	ncy	Base frequency set as required between 0 and 400Hz. Constant torque or variable torque					
S		acteristic		pattern can be selected.					
ntro	Start	ing torque		150%: At 0.5Hz (for advanced magnetic flux vector control)					
Ο̈	Torq	ue boost		Manual torque boost					
	Acce	eleration/de	eceleration	0 to 3600 s (acceleration and deceleration can be set individually), linear or S-pattern					
		setting		acceleration/deceleration mode can be selected.					
		lynamic br		Operation frequency (0 to 120Hz), operation time (0 to 10 s), voltage (0 to 30%) variable					
	Stall level	prevention	operation	Operation current level can be set (0 to 200% variable), presence or absence can be selected.					
	F		Analog input	0 to 5VDC, 0 to 10VDC, 0 to ±10VDC, 4 to 20mADC					
	settir signa	_	Digital input	3-digit BCD or 12-bit binary using operation panel or parameter unit (when the FR-A5AX option is used)					
	Start	signal		Forward and reverse rotation, start signal automatic self-holding input (3-wire input) can be selected.					
		Multi-speed selection		Up to 15 speeds can be selected. (Each speed can be set between 0 and 400Hz, running speed can be changed during operation from the PU (FR-DU04/FR-PU04).)					
	Input signals	Second, third acceleration/ deceleration time selection		0 to 3600 seconds (up to three different accelerations and decelerations can be set individually.)					
suo	Input s	Jog operation selection		Provided with jog operation mode select terminal (Note 1)					
ati		Current input selection		Input of frequency setting signal 4 to 20mADC (terminal 4) is selected.					
cific		Output stop		Instantaneous shut-off of inverter output (frequency, voltage)					
be		Alarm reset		Alarm retained at the activation of protective function is reset.					
Operational specifications	Operation functions			Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, polarity reversible operation, automatic restart operation after instantaneous power failure, commercial power supply-inverter switch-over operation, forward/reverse rotation prevention, slip compensation, operation mode selection, offline auto tuning function, online auto tuning function, PID control, programmed operation, computer link operation (RS-485)					
)	Output signals	Operatino	g status	5 different signals can be selected from inverter running, up to frequency, instantaneous power failure (undervoltage), frequency detection, second frequency detection, third frequency detection, during program mode operation, during PU operation, overload alarm, regenerative brake pre-alarm, electronic overcurrent protection pre-alarm, zero current detection, output current detection, PID lower limit, PID upper limit, PID forward/reverse rotation, commercial power supply-inverter switch-over MC1, 2, 3, operation ready, brake release request, fan fault and fin overheat pre-alarm minor fault. Open collector output.					
	put	Alarm (in	verter trip)	Contact outputchange-over contact (230VAC 0.3A, 30VDC 0.3A) Open collectoralarm code (4 bit) output					
	For meter		r	1 signal can be selected from output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed, motor torque, converter output voltage (steady or peak value), regenerative brake duty, electronic overcurrent protection load factor, input power, output power, load meter, and motor exciting current. Pulse train output (1440 pulses/sec./full scale) and analog output (0 to 10VDC).					
	PU (FR-DU04 sta		Operating status	Selection can be made from output frequency, motor current (steady or peak value), output voltage, frequency setting, running speed, motor torque, overload, converter output voltage (steady or peak value), electronic overcurrent protection load factor, input power, output power, load meter, motor exciting current, cumulative energization time, actual operation time, watt-hour meter, regenerative brake duty and motor load factor.					
Display			Alarm definition	Alarm definition is displayed when protective function is activated. 8 alarm definitions are stored. (Four alarm definitions are only displayed on the operation panel.)					
	Additional (Operating	Input terminal signal states, output terminal signal states, option fitting status, terminal assignment status					
Dis			status	assignment status					
Dis	displ para	tional ay on meter unit PU04)	Alarm definition	Output voltage/current/frequency/cumulative energization time immediately before protective function is activated					

SPECIFICATIONS

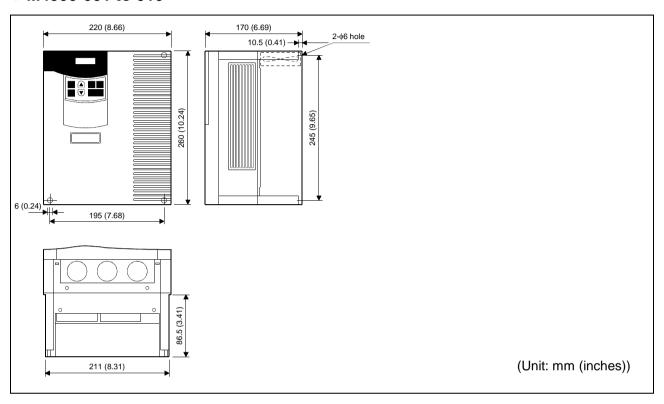
Prot	ective/alarm functions	Overcurrent shut-off (during acceleration, deceleration, constant speed), regenerative overvoltage shut-off, undervoltage, instantaneous power failure, overload shut-off (electronic overcurrent protection), brake transistor alarm (Note 2), ground fault current, output short circuit, main circuit device overheat, stall prevention, overload alarm, brake resistor overheat protection, fin overheat, fan fault, option fault, parameter error, PU disconnection				
Environment	Ambient temperature	Constant torque: -10°C to +40°C (14°F to 104°F) (non-freezing) (-10°C to +30°C with FR-A5CV□□ attachment) Variable torque: -10°C to +40°C (14°F to 104°F) (non-freezing) (-10°C to +30°C with FR-A5CV□□ attachment)				
п	Ambient humidity	90%RH or less (non-condensing)				
iro	Storage temperature (Note 3)	-20°C to +65°C (-4°F to +149°F)				
	Ambience	Indoors. (No corrosive and flammable gases, oil mist, dust and dirt.)				
	Altitude, vibration	Maximum 1000m (3280.80 feet) above sea level for standard operation. After that derate by 3% for every extra 500m up to 2500m (91%). 5.9 m/s ² {0.6G} or less (conforming to JIS C0911)				

- Note: 1. Jog operation may also be performed from the operation panel or parameter unit.
 - 2. Not provided for the M4500-025 to 100 which do not have a built-in brake circuit.
 - 3. Temperature applicable for a short period in transit, etc.

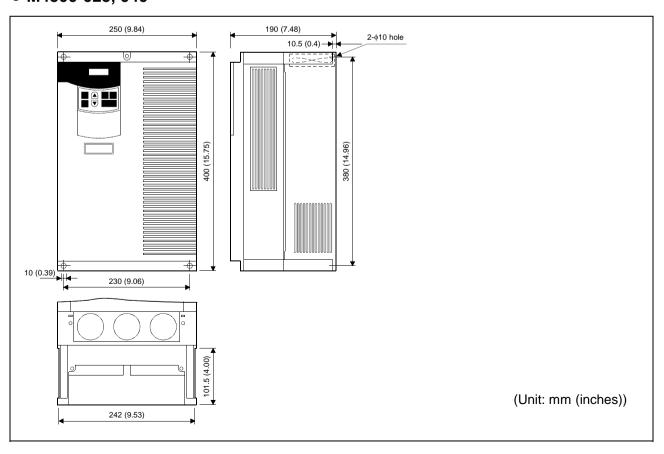
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6.1.3 Outline drawings

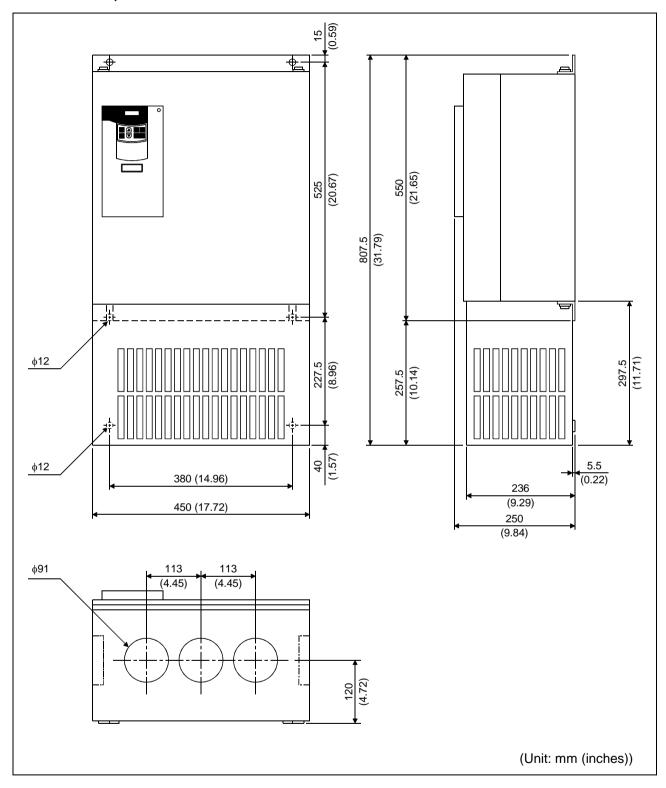
• M4500-001 to 010



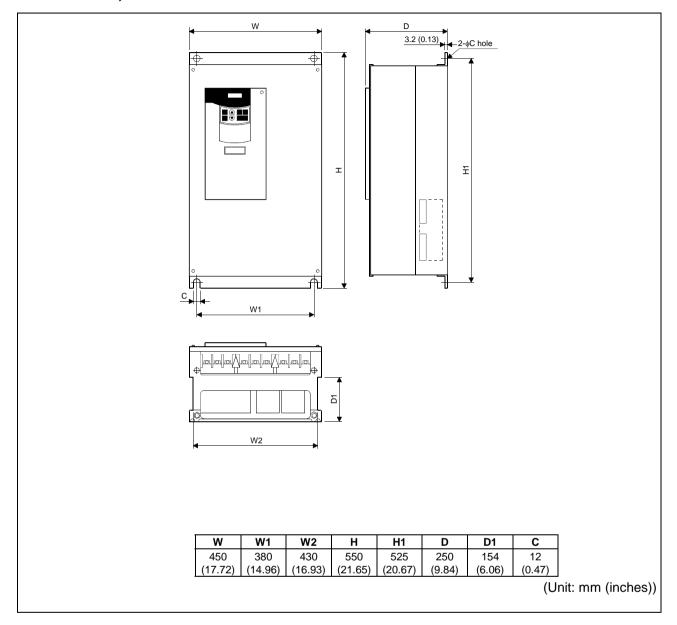
• M4500-025, 040



● M4500-060, 100 with the attachment for conduit connection



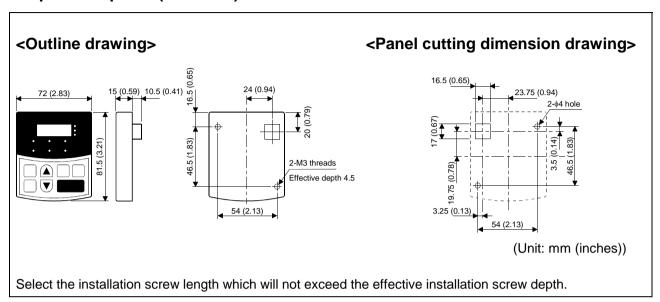
● M4500-060, 100 without the attachment for conduit connection



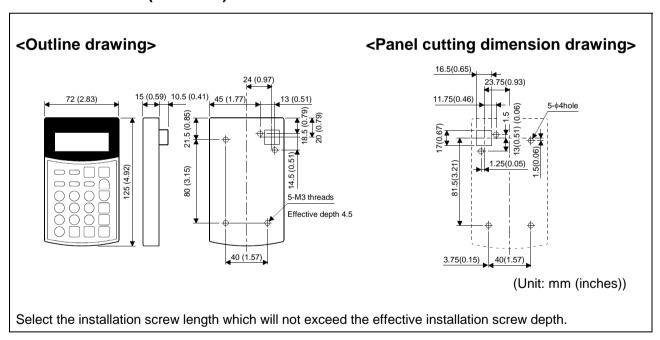
6

SPECIFICATIONS

Operation panel (FR-DU04)



Parameter unit (FR-PU04)



CHAPTER 7 OPTIONS

This chapter describes the "options" of this product. Always read the instructions before using the equipment.

Chapter 1

Chapter 2

Chapter 3

Chapter 4

Chapter 5

Chapter 6

7.1 Option List

OPTIONS

7.1.1 Stand-alone options

Name	Туре	Applicable Models	Description
Parameter unit (8 languages)	FR-PU04-MGI	M4500-001 to 100	Parameter Unit, 24-key, Multi-language, Back-lit LCD display
Parameter unit connection cable	FR-CB20□	M4500-001 to 100	Control Panel / Parameter Unit extension cable □=1,3, or 5 for length in meters
Cooling fin protrusion attachment	FR-A5CN02	M4500-001 to 010	Adapter for through enclosure mounting of
	FR-A5CN04	M4500-025/040	heat sink and cooling fan
attacriment	FR-A5CN06	M4500-060/100	fleat sink and cooling fair
Totally enclosed structure	FR-A5CV01	M4500-001 to 010	Enclosure upgrade to IP40. Note: Use of this accessory reduces the
specification attachment	FR-A5CV02	M4500-025/040	VFD ambient temperature rating to 30 deg. C (86 deg. F)
Line noise filter	FR-BSF01	M4500-001 to 005	For line noise reduction (applies for small size of 3.7K or less)
	FR-BLF	M4500-001 to 100	For line noise reduction

7.1.2 Inboard dedicated options

■ Inboard options

	Name	Туре	Function
12-b	12-bit digital input FR-A5AX		 Input interface used to set the inverter frequency accurately using external 3-digit BCD or 12-bit binary-coded digital signals. Gains and offsets can also be adjusted.
Digit	tal output		Among 26 standard output signals of the inverter, this option outputs any 7 selected signals from open collector output terminals.
Exte	ension analog out	FR-A5AY	 Outputs extra 16 signals which can be monitored on the FM and AM terminals such as output frequency, 20mADC or 5V(10V)DC meter can be connected.
Rela	ay output	FR-A5AR	Among 26 standard output signals of the inverter, this option outputs any 3 selected signals from relay contact output terminals.
Orie outp	ntation, PLG ut	FR-A5AP	 Used with a position detector (pulse encoder) installed on a machine tool spindle to stop the spindle in position (orientation control). The motor speed is detected by the pulse encoder and this detection signal is fed back to the inverter to automatically compensate for speed variation. Hence, the motor speed can be kept constant if load variation occurs. The current spindle position and actual motor speed can be monitored on the operation panel or parameter unit.
Puls	e train input		A pulse train signal can be used to enter the speed command to the inverter.
tion	Computer link	FR-A5NR	 Operation/monitoring/parameter change of the inverter can be performed under the control of a user program from a computer, e.g. personal computer or FA controller, connected by a communication cable. Noise-immune communication system using twisted pair cables.
unicai	Profibus DP	FR-A5NP	Operation/monitoring/parameter change of the inverter can be performed from a computer or PLC.
Communication	Device Net™	FR-A5ND	Operation/monitoring/parameter change of the inverter can be performed from a computer or PLC.
	CC-Link (Note 2)	FR-A5NC	Operation/monitoring/parameter change of the inverter can be performed from a PLC.
	Modbus Plus FR-A5		Operation/monitoring/parameter change of the inverter can be performed from a computer or PLC.

Note: 1. Three inboard options may be mounted at the same time (the number of the same options mountable is only one, and only one of the communication options may be mounted.)

- 2. CC-Link stands for Control & Communication Link.
- 3. The FR-A5AX (12-bit digital input) is required for orientation control.

MEMO

This chapter provides the "appendices" for use of this product.

Always read the instructions before using the equipment.

Appendix 1	Data Code	List	202
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_			Data Codes			
Func- tion	Parameter Number	Name	Read	Write	Link Parameter Extension Setting (Data code 7F/FF)	
	0	Torque boost	00	80	0	
	1	Maximum frequency	01	81	0	
us	2	Minimum frequency	02	82	0	
Ę	3	Base frequency	03	83	0	
Basic functions	4	Multi-speed setting (high speed)	04	84	0	
<u>5</u>	5	Multi-speed setting (middle speed)	05	85	0	
3as	6	Multi-speed setting (low speed)	06	86	0	
<u> </u>	7	Acceleration time	07	87 88	0	
	8 9	Deceleration time	08 09	89		
	10	Electronic thermal O/L relay DC injection brake operation frequency	09 0A	8A	0	
	11	DC injection brake operation frequency DC injection brake operation time	0B	8B	0	
	12	DC injection brake voltage	0C	8C	0	
	13	Starting frequency	0D	8D	0	
	14	Load pattern selection	0E	8E	0	
	15	Jog frequency	0F	8F	0	
	16	Jog acceleration/deceleration time	10	90	0	
	17	MRS input selection	11	91	0	
	18	High-speed maximum frequency	12	92	0	
"	19	Base frequency voltage	13	93	0	
Si O	20	Acceleration/deceleration reference frequency	14	94	0	
ncti	21	Acceleration/deceleration time increments	15	95	0	
Ę	22	Stall prevention operation level	16	96	0	
Standard operation functions	23	Stall prevention operation level at double speed	17	97	0	
obe	24	Multi-speed setting (speed 4)	18	98	0	
Ð	25	Multi-speed setting (speed 5)	19	99	0	
nda	26	Multi-speed setting (speed 6)	1A	9A	0	
Stal	27	Multi-speed setting (speed 7)	1B	9B	0	
•,	28	Multi-speed input compensation	1C	9C	0	
	29	Acceleration/deceleration pattern	1D	9D	0	
	30	Regenerative function selection	1E	9E	0	
	31	Frequency jump 1A	1F	9F	0	
	32	Frequency jump 1B	20	A0	0	
	33 34	Frequency jump 2A	21 22	A1 A2	0	
	35	Frequency jump 2B Frequency jump 3A	23	A2 A3	0	
	36	Frequency jump 3B	24	A3 A4	0	
	37	Speed display	25	A5	0	
sc	41	Up-to-frequency sensitivity	29	A9	0	
Output terminal functions	42	Output frequency detection	2A	AA	0	
	43 44	Output frequency detection for reverse rotation Second acceleration/deceleration time	2B 2C	AB	0	
SUC	45	Second deceleration time Second deceleration time	2C 2D	AC AD	0	
ctic	46	Second torque boost	2E	AE	0	
Second functions	47	Second V/F (base frequency)	2F	AF	0	
pu	48	Second stall prevention operation current	30	B0	0	
900	49	Second stall prevention operation frequency	31	B1	0	
ο̈	50	Second output frequency detection	32	B2	0	
	52	DU/PU main display data selection	34	B4	0	
Display functions	53	PU level display data selection	35	B5	0	
spk ctio	54	FM terminal function selection	36	B6	0	
لِيَّ كَ	55	Frequency monitoring reference	37	B7	0	
	56	Current monitoring reference	38	B8	0	
Rated output current	57	Automatic restart functions	39	В9	0	
Ra out cur	58	Restart coasting time	3A	ВА	0	

_			Data Codes			
Func- tion	Parameter Number	Name	Read	Write	Link Parameter Extension Setting (Data code 7F/FF)	
Additional function	59	Remote setting function selection	3B	ВВ	0	
	60	Intelligent mode selection	3C	BC	0	
	61	Reference current	3D	BD	0	
	62	Reference current for acceleration	3E	BE	0	
	63	Reference current for deceleration	3F	BF	0	
	64	Starting frequency for elevator mode	40	C0	0	
ω	65	Retry selection	41	C1	0	
Operation selection functions	66	Stall prevention operation level reduction starting frequency	42	C2	0	
Ē	67	Number of retries at alarm occurrence	43	C3	0	
u o	68	Retry waiting time	44	C4	0	
ecti	69	Retry count display erasure	45	C5	0	
seli	70	Special regenerative brake duty	46	C6	0	
o u	71	Applied motor	47	C7	0	
rati	72	PWM frequency selection	48	C8	0	
be	73 74	0-5V/0-10V selection Filter time constant	49 4A	C9 CA	0	
	75	Reset selection/disconnected PU detection/PU	4A 4B	СВ	0	
	76	stop selection Alarm code output selection	4C	CC	0	
	77	Parameter write disable selection	4C 4D	None	0	
	78	Reverse rotation prevention selection	4E	CE	0	
	79	Operation mode selection	4F	None	0	
	80	Motor capacity	50	D0	0	
	81	Number of motor poles	51	D1	0	
×	82	Motor exciting current	52	D2	0	
Advanced magnetic flux vectorcontrol	83	Rated motor voltage	53	D3	0	
etic ol	84	Rated motor frequency	54	D4	0	
nced magneti vectorcontrol	89	Speed control gain	59	D9	0	
n Sic	90	Motor constant (R1)	5A	DA	0	
ect	91	Motor constant (R2)	5B	DB	0	
, and	92	Motor constant (L1)	5C	DC	0	
γg	93	Motor constant (L2)	5D	DD	0	
	94	Motor constant (X)	5E	DE	0	
	95	Online auto tuning selection	5F	DF	0	
	96	Auto tuning setting/status	60	E0	0	
	100 101	V/F1 (first frequency) V/F1 (first frequency voltage)	00 01	80 81	1 1	
F	101	V/F2 (second frequency)	02	82	1	
e V	102	V/F2 (second frequency) V/F2 (second frequency voltage)	03	83	1	
dible	104	V/F3 (third frequency)	04	84	1	
fley	105	V/F3 (third frequency voltage)	05	85	1	
5-point flexible V/F characteristics	106	V/F4 (fourth frequency)	06	86	1	
9. P.	107	V/F4 (fourth frequency voltage)	07	87	1	
ις	108	V/F5 (fifth frequency)	08	88	1	
	109	V/F5 (fifth frequency voltage)	09	89	1	
	110	Third acceleration/deceleration time	0A	8A	1	
Suc	111	Third deceleration time	0B	8B	1	
ctic	112	Third torque boost	0C	8C	1	
fun	113	Third V/F (base frequency)	0D	8D	1	
Third functions	114	Third stall prevention operation current	0E	8E	1	
두	115	Third stall prevention operation frequency	0F	8F	1	
	116	Third output frequency detection	10	90	1	

			Data Codes			
Func- tion	Parameter Number	Name	Read	Write	Link Parameter Extension Setting (Data code 7F/FF)	
	117	Station number	11	None	1	
Communication functions	118	Communication speed	12	None	1	
mmunicat functions	119	Stop bit length/data length	13	None	1	
ctic	120 121	Parity check presence/absence	14 15	None None	<u> </u>	
mu fun	121	Number of communication retries Communication check time interval	16	None	<u></u>	
Co	123	Waiting time setting	17	None	1	
_	124	CR, LF presence/absence selection	18	None	<u>'</u> 1	
	128	PID action selection	1C	9C	<u>·</u> 1	
_	129	PID proportional band	1D	9D	1	
PID control	130	PID integral time	1E	9E	1	
cor	131	Upper limit	1F	9F	1	
₽	132	Lower limit	20	A0	1	
	133	PID action set point for PU operation	21	A1	1	
	134	PID differential time	22	A2	1	
wer	135	Commercial power supply-inverter switch-over sequence output terminal selection	23	А3	1	
po erte	136	MC switch-over interlock time	24	A4	1	
cial Figure	137	Start waiting time	25	A5	1	
Commercial power supply-inverter switch-over	138	Commercial power supply-inverter switch-over selection at alarm occurrence	26	A6	1	
Cor	139	Automatic inverter-commercial power supply switch-over frequency	27	A7	1	
_	140	Backlash acceleration stopping frequency	28	A8	1	
Backlash	141	Backlash acceleration stopping time	29	A9	1	
Š	142	Backlash deceleration stopping frequency	2A	AA	1	
Ba	143	11 0 1 2	2B	AB	1	
D:-	143	Backlash deceleration stopping time	2B 2C	AC	1	
Dis- play	144	Speed setting switch-over Parameter unit language switch-over	2C 2D	AD	<u></u>	
<u> </u>	148	Stall prevention level at 0V input	30	B0	1	
Addit- ional functions	149	Stall prevention level at 10V input	31	B1	1	
	150	Output current detection level	32	B2	1	
Current	151	Output current detection period	33	В3	1	
Current	152	Zero current detection level	34	B4	1	
ರ ಕಿ	153	Zero current detection period	35	B5	1	
Su	154	Voltage reduction selection during stall prevention operation	36	B6	1	
cţio	155	RT activated condition	37	B7	1	
Sub functions	156	Stall prevention operation selection	38	B8	<u>.</u> 1	
d t	157	OL signal waiting time	39	B9	1	
σ	158	AM terminal function selection	ЗА	BA	1	
Additional function	160	User group read selection	00	80	2	
Restart after instantaneous power failure	162	Automatic restart after instantaneous power failure selection	02	82	2	
art Itar	163	First cushion time for restart	03	83	2	
test star	164	First cushion voltage for restart	04	84	2	
ᄺᆴᅗ	165	Restart stall prevention operation level	05	85	2	
ial	170	Watt-hour meter clear	0A	8A	2	
Initial monitor	171	Actual operation hour meter clear	0B	8B	2	
"	173	User group 1 registration	0D	8D	2	
User	174	User group 1 deletion	0E	8E	2	
User	175	User group 2 registration	0F	8F	2	
Į Į	176	User group 2 deletion	10	90	2	
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_	<u> </u>			Data Codes			
Func- tion	Parameter Number	Name	Read	Write	Link Parameter Extension Setting (Data code 7F/FF)		
	180	RL terminal function selection	14	94	2		
ns	181	RM terminal function selection	15	95	2		
Terminal assignment functions	182	RH terminal function selection	16	96	2		
oun ou	183	RT terminal function selection	17	97	2		
nt f	184	AU terminal function selection	18	98	2		
ше	185	JOG terminal function selection	19	99	2		
ign	186	CS terminal function selection	1A	9A	2		
388	190	RUN terminal function selection	1E	9E	2		
<u>a</u>	191	SU terminal function selection	1F	9F	2		
nin	192	IPF terminal function selection	20	A0	2		
en	193	OL terminal function selection	21	A1	2		
_	194	FU terminal function selection	22	A2	2		
	195	ABC terminal function selection	23	A3	2		
Additional function	199	User's initial value setting	27	A7	2		
	200	Programmed operation minute/second selection	3C	ВС	1		
	201	Program setting 1	3D	BD	1		
	202	Program setting 1	3E	BE	1		
	203	Program setting 1	3F	BF	1		
	204	Program setting 1	40	C0	1		
	205	Program setting 1	41	C1	1		
	206	Program setting 1	42	C2	1		
	207	Program setting 1	43	C3	1		
	208	Program setting 1	44	C4	1		
	209	Program setting 1	45	C5	1		
	210	Program setting 1	46	C6	1		
uc	211	Program setting 2	47	C7	1		
rati	212	Program setting 2	48	C8	1		
bei	213 214	Program setting 2 Program setting 2	49 4A	C9 CA	1 1		
ор	214	5 5	4A 4B	CB	1		
Programmed operation	216	Program setting 2	4B 4C	CC	1		
am	217	Program setting 2 Program setting 2	4C 4D	CD	1		
ogr	217	Program setting 2	4E	CE	1		
Ā	219	Program setting 2	4F	CF	1		
	220	Program setting 2	50	D0	1		
	221	Program setting 3	51	D1	1		
	222	Program setting 3	52	D2	1		
	223	Program setting 3	53	D3	1		
	224	Program setting 3	54	D4	1		
	225	Program setting 3	55	D5	1		
	226	Program setting 3	56	D6	1		
	227	Program setting 3	57	D7	1		
	228	Program setting 3	58	D8	1		
	229	Program setting 3	59	D9	1		
	230	Program setting 3	5A	DA	1		
	231	Timer setting	5B	DB	1		
	232	Multi-speed setting (speed 8)	28	A8	2		
_	233	Multi-speed setting (speed 9)	29	A9	2		
ed Jn	234	Multi-speed setting (speed 10)	2A	AA	2		
spe atic	235	Multi-speed setting (speed 11)	2B	AB	2		
Multi-speed operation	236	Multi-speed setting (speed 12)	2C	AC	2		
≨°	237	Multi-speed setting (speed 13)	2D	AD	2		
	238	Multi-speed setting (speed 14)	2E	AE	2		
	239	Multi-speed setting (speed 15)	2F	AF	2		

	_ Data Codes				a Codes
Func- tion	Parameter Number	Name	Read	Write	Link Parameter Extension Setting (Data code 7F/FF)
Sub	240	Soft-PWM setting	30	В0	2
Sub function	244	Cooling fan operation selection	34	B4	2
Stop selection function	250	Stop selection	ВА	2	
lac c	251	Output phase failure protection selection	3B	BB	2
Additional	252	Override bias	3C	ВС	2
Ad	253	Override gain	3D	BD	2
	261	Power failure stop selection	45	C5	2
Power failure stop functions	262	Subtracted frequency at deceleration start	46	C6	2
ailu	263	Subtraction starting frequency	47	C7	2
er f	264	Power-failure deceleration time 1	48	C8	2
owe op f	265	Power-failure deceleration time 2	49	C9	2
Stc P	266	Power-failure deceleration time switch-over frequency	4A	CA	2
Function	270	Stop-on-contact/load torque high-speed frequency control selection	4E	CE	2
р »	271	High-speed setting maximum current	4F	CF	2
High speed frequency control	272	Mid-speed setting minimum current	50	D0	2
igh s requ con	273	Current averaging range	51	D1	2
±	274	Current averaging filter constant	52	D2	2
Stop on contact	275	Stop-on-contact exciting current low-speed multiplying factor	53	D3	2
Stop	276	Stop-on-contact PWM carrier frequency	54	D4	2
	278	Brake opening frequency	56	D6	2
Se	279	Brake opening current	57	D7	2
ner Sc	280	Brake opening current detection time	58	D8	2
Brake sequence functions	281	Brake operation time at start	59	D9	2
our nuc	282	Brake operation frequency	5A	DA	2
ak T	283	Brake operation time at stop	5B	DB	2
ā	284	Deceleration detection function selection	5C	DC	2
	285	Overspeed detection frequency	5D	DD	2
Droop	286	Droop gain	SE	DE	2
	287	Droop filter constant	SF	DF	2
	300	BCD code input bias	00	80	3
<u>ra</u>	301	BCD code input gain	01	81	3
digi.	302	Binary input bias	02	82	3
bit dig input	303	Binary input gain	03	83	3
12-bit digital input	304	Selection of whether digital input and analog compensation input are enabled or disabled	04	84	3
	305	Data read timing signal on/off selection	05	85	3
	306	Analog output signal selection	06	86	3
	307	Setting for zero analog output	07	87	3
ŭ	308	Setting for maximum analog output	08	88	3
Analog output, digital output	309	Analog output signal voltage/current switch- over	09	89	3
ligita	310	Analog meter voltage output selection	0A	8A	3
ıt, d	311	Setting for zero analog meter voltage output Setting for maximum analog meter voltage	0B	8B	3
outpu	312	output	0C	8C	3
) gc	313	Y0 output selection	0D	8D	3
Jak	314	Y1 output selection	0E	8E	3
Ā	315	Y2 output selection	0F	8F	3
	316	Y3 output selection	10	90	3
	317	Y4 output selection	11	91	3

F	Doromotor	Name		Data Codes			
Func- tion	Parameter Number			Read	Write	Link Parameter Extension Setting (Data code 7F/FF)	
Analog output, digital output	318	Y5 out	put selection	12	92	3	
Ana output, out	319	Y6 out	put selection	13	93	3	
ıt .	320	RA1 ou	utput selection	14	94	3	
Relay output	321	RA2 ou	utput selection	15	95	3	
& 9	322	RA3 ou	utput selection	16	96	3	
	330	RA out	put selection	1E	9E	3	
	331	Inverte	r station number	1F	9F	3	
_	332	Comm	unication speed	20	A0	3	
Computer link function	333	Stop b	it length	21	A1	3	
our	334	Parity (check yes/no	22	A2	3	
k fı	335	Comm	unication retry count	23	A3	3	
<u>li</u>	336	Comm	unication check time interval	24	A4	3	
ıter	337	Waiting	g time setting	25	A5	3	
Jbr	338	Operat	ion command right	26	A6	3	
Son	339	Speed	command right	27	A7	3	
	340	Link st	art mode selection	28	A8	3	
	341	CR, LF	yes/no selection	29	A9	3	
	342	E ² PRC	DM write yes/no	2A	AA	3	
S	900	FM terminal calibration		5C	DC	1	
ion	901	AM ter	minal calibration	5D	DD	1	
Calibration functions	902	Freque	ency setting voltage bias	5E	DE	1	
) fu	903	Freque	ency setting voltage gain	5F	DF	1	
tior	904	Freque	ency setting current bias	60	E0	1	
ora	905	Freque	ency setting current gain	61	E1	1	
alil	990	Buzzer control		5A	DA	9	
0	991	LCD contrust		5B	DB	9	
	_	Second	d parameter switch-over	6C	EC	<u>—</u>	
	_	Frequency setting	Running frequency (RAM)	6D	ED	_	
	_	Frequent	Running frequency (E ² PROM)	6E	EE	_	
	_	>-	Monitor	6F		_	
	_	Frequency	Output current monitor	70	_	_	
	_	reque	Output voltage monitor	71	_	_	
		ĒĒ	Special monitor	72		_	
	_		Special monitor selection No.	73	F3	_	
	_	a a	Most recent No. 1, No. 2/alarm display clear	74	F4	_	
,	_	Alarm display	Most recent No. 3, No. 4	75		_	
,			Most recent No. 5, No. 6	76		_	
	_		Most recent No. 7, No. 8	77		_	
	_		r status monitor/run command	7A	FA	_	
			ion mode acquisition	7B	FB	_	
	_	All clea		_	FC	_	
		Inverte			FD	_	
	_	Link pa	arameter extension setting	7F	FF	_	

REVISIONS

* The manual number is given on the bottom left of the back cover.

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